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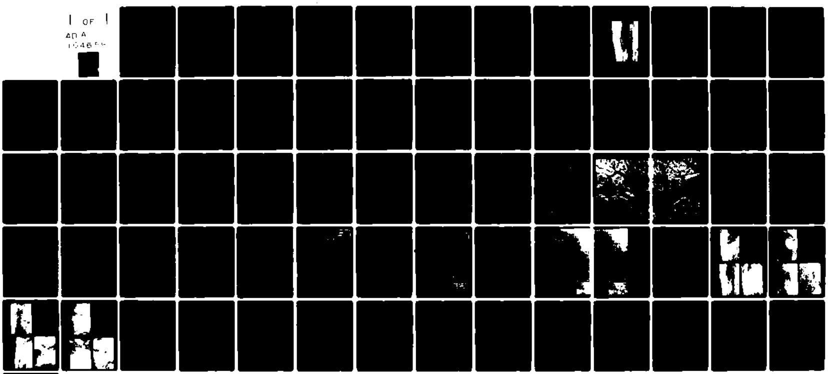

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UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

ATWOOD LAKE DAM
CAMP CEDAR LEDGE
GIRL SCOUT COUNCIL OF GREATER ST. LOUIS
JEFFERSON COUNTY, MISSOURI
MO 31171

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
FOR: STATE OF MISSOURI

DECEMBER 1980

UNCLASSIFIED

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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PHASE 1 INSPECTION REPORT
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

SUBJECT: Atwood Lake Dam, MO 31171, Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Atwood Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

The owner should initiate immediate action to provide an erosion-free emergency spillway so that the full existing spillway capacity could be utilized. With an erosion-free emergency spillway, the spillways will pass greater than 50 percent of the Probable Maximum Flood.

Non-implementation of this recommendation will result in an unsafe, non-emergency classification, due to degradation of the emergency spillway crest which could cause dam failure by floods exceeding 42 percent of the Probable Maximum Flood.

SUBMITTED BY: SIGNED — Chief, Engineering Division — 23 MAR 1981 (Date)

APPROVED BY: SIGNED — Colonel, CE, District Engineer — 24 MAR 1981 (Date)

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ATWOOD LAKE DAM

MISSOURI INVENTORY NO. 31171

JEFFERSON COUNTY, MISSOURI

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

CORPS OF ENGINEERS

DECEMBER 1980

HS-8011

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Atwood Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Tributary of Sandy Creek
Date of Inspection:	8 October 1980

The Atwood Lake Dam was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of these hydrologic/hydraulic investigations, the present general condition of the dam is considered to be satisfactory. However, several items were noticed during the inspection which are considered to have an adverse effect on the overall safety and future operation of the dam. These items include erosion of the upstream face of the embankment, trees and areas of dense undergrowth on the downstream face of the embankment, and erosion of the emergency spillway outlet channel. Animal burrows were not observed during the inspection, but their presence was indicated by Mr. LaPlant, the camp caretaker.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Atwood Lake Dam, which is classified as small in size and of high hazard potential, is specified to be a minimum of one-half the Probable Maximum Flood (PMF). Considering the fact that a relatively small volume of water is impounded by the dam, that the flood plain downstream of the dam is fairly broad, and that there are but three dwellings within the estimated flood damage zone, it is recommended that the spillways for this dam be designed for one-half the PMF. The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Results of a hydrologic/hydraulic analysis indicated the spillways, principal plus emergency, are inadequate to safely pass lake outflow resulting from a storm of one-half PMF magnitude without significant degradation by erosion of the emergency spillway crest. The spillways are capable of passing lake outflow resulting from the one percent chance (100-year frequency) flood and the outflow corresponding to about 42 percent of the PMF. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be one mile. Within the potential flood damage zone are three dwellings and a farm building.

A review of available data did not disclose that seepage or stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein. Restoration and protection of the upstream face of the dam should be assigned a high priority.

Harold B. Lockett

Harold B. Lockett
P. E. Missouri E-4189

Albert B. Becker, Jr.

Albert B. Becker, Jr.
P. E. Missouri E-9168

OVERVIEW ATWOOD LAKE DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

ATWOOD LAKE DAM - MO 31171

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

ATWOOD LAKE DAM - MO 31171

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, directed that a safety inspection of the Atwood Lake Dam be made.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this inspection, determine if the dam poses a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in the "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report to the Chief of Engineers on the National Program of Inspection of Non-Federal Dams", dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Atwood Lake Dam is an earthfill type embankment rising approximately 27 feet above the natural streambed at the downstream toe of the barrier. The upstream side of the embankment, according to information shown on the dam construction drawings, is indicated to have a slope of 1v on 2.5h; however, because of erosion, the slope has become considerably steeper above the normal waterline across most of the dam. The downstream side of the dam is somewhat irregular with a slope of approximately 1v on 2.2h near the top of the structure, but becoming flatter, about 1v on 2.9h, near the base of the dam. The width of the crest is approximately 12 feet and the dam is about 473 feet long. A plan and profile of the dam is shown on Plate 3, a cross-section of the dam is shown on Plate 4, and an overview photograph of the dam is shown following the preface at the front of the report. At normal pool elevation, the reservoir impounded by the dam occupies approximately 7 acres.

The dam has both a principal and an emergency spillway. The principal spillway, a 4-foot square reinforced concrete drop inlet structure with a concrete back wall that serves to protect the dam and a 48-inch diameter pipe outlet that passes through the dam, is located at the right, or south, end of the dam. The drop inlet structure is about 8.9 feet deep. A 6-inch valve located in the bottom of the structure is provided to allow partial lake drawdown. The outlet channel for the principal spillway follows a course along the hillside of the right abutment for about 63 feet before dropping abruptly at a sandstone outcropping to the original stream channel downstream of the dam. A profile of the principal spillway outlet is shown on Plate 4.

The emergency spillway is located at the left, or north, abutment. The spillway outlet channel, an excavated earthen trapezoidal section, is cut into the hillside at the end of the dam. An earthen bank that serves to confine flow to the channel and protect the dam is constructed on the right side of the channel. The bank extends to a point approximately 60 feet downstream of the center of the dam. Just beyond the end of the bank, the outlet channel bends to the south and flows along a course that closely parallels the dam. The spillway outlet channel appears to join the original stream channel at a point about 40 feet downstream of the dam. A profile of the emergency spillway crest section and a cross-section of the spillway at the centerline of the dam, are shown on Plate 5.

b. <u>Location</u>. The dam is located on an unnamed tributary of Sandy Creek about 0.6 mile northwest of the intersection of Sandy Road and the entrance road to Camp Cedar Ledge; and about 3.5 miles northeast of the community of Pevely, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located within U. S. Survey 437, approximately 1,100 feet southeast and 250 feet northeast of the northwest corner of Survey 437, in Township 41 North, Range 5 East, in Jefferson County.

c. <u>Size Classification</u>. The size classification based on the height of the dam and storage capacity, is categorized as small (per Table 1, Recommended Guidelines for Safety Inspection of Dams).

d. <u>Hazard Classification</u>. The Atwood Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes, or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends one mile downstream of the dam. Within the possible damage zone are three dwellings and a farm building. Those features lying within the downstream damage zone as reported by the St. Louis District, Corps of Engineers, were verified by the inspection team.

e. <u>Ownership</u>. The lake and dam are owned by the Girl Scout Council of Greater St. Louis. The main office of the Girl Scout organization is located at 915 Olive Street, St. Louis, Missouri, 63101. Mr. Gary Winzenburger, Property Manager, is the Owner's representative.

f. <u>Purpose of Dam</u>. The dam impounds water for recreational use by the Girl Scout organization.

g. <u>Design and Construction History</u>. According to Ms. Amanda Schlueter, the original dam, a structure approximately 17 feet high, was built by her father, Henry Schlueter, sometime around 1935. Ms. Schlueter reported that her father was a farmer by occupation and constructed the dam during his spare time. In 1969, following acquisition of the property by the Girl Scout Council of Greater St. Louis, based on plans prepared jointly by Reitz & Jens, Consuting Engineers, St. Louis, Missouri, and U. S. Department of Agriculture, Soil Conservation Service, the dam was raised approximately 10 feet and new spillways were provided. Construction plans bearing the Reitz & Jens title block for these dam improvements, reference Plates 6 through 8, are included herein. The contractor that performed the work indicated on the plans could not be determined. Since improving the dam in 1969, there have been no subsequent changes or additions to the structure.

h. Normal Operational Procedure. The lake level is unregulated. Lake outflow is governed by the combined capacities of a drop inlet type principal spillway and an excavated earth type emergency spillway.

1.3 PERTINENT DATA

a. Drainage Area. Except for some pasture land in the southern part of the watershed, the area tributary to the lake is for the most part in a native state covered with timber. The watershed above the dam amounts to approximately 93 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

1. Estimated known maximum flood at damsite ... 10 cfs* (W.S. Elev. 475.3)
2. Spillway capacity
    a. Principal ... 106 cfs (W.S. Elev. 476.8)
    b. Principal + emergency ... 403 cfs (W.S. Elev. 478.8)

c. Elevation (Ft. above MSL). The following elevations were determined by survey and are based on topographic data shown on the 1954 U.S.G.S. Herculaneum, Missouri, Quadrangle Map, 7.5 Minute Series, photorevised 1968 and 1974.

1. Observed pool ... 474.6
2. Normal pool ... 475.0
3. Spillway crest
    a. Principal ... 475.0
    b. Emergency ... 476.8
4. Maximum experienced pool ... 475.3*
5. Top of dam ... 479.8 (Min.)
6. Effective top of dam . . . 478.8**

*Based on an estimate of lake level as observed by Mr. James E. LaPlant, Camp Ranger.

**Elevation at which lake outflow within emergency spillway exceeds permissible velocity.

7. Streambed at centerline of dam ... 454± (Est.)

8. Maximum tailwater ... Unknown

9. Observed tailwater ... None

d. Reservoir.

1. Length at normal pool (Elev. 475.0) ... 1,050 ft.

2. Length of pool at top of dam (Elev. 479.8) ... 1,200 ft.

e. Storage.

1. Normal pool ... 43 ac. ft.

2. Top of dam (incremental) ... 37 ac. ft.

f. Reservoir Surface.

1. Normal pool ... 7 acres

2. Top of dam (incremental) ... 2 acres

g. Dam. The height of the dam is defined to be the overall vertical distance from the lowest point of foundation surface at the downstream toe of the barrier, to the top of the dam.

1. Type ... Earthfill
2. Length ... 473 ft.
3. Height ... 27 ft.
4. Top width ... 12 ft.
5. Side slopes
   a. Upstream ... lv on 1.5h (above waterline, eroded)
   b. Downstream ... lv on 2.2h to lv on 2.9h
6. Cutoff ... Core trench*
7. Slope protection
   a. Upstream ... Grass
   b. Downstream ... Grass

*Per construction drawings by Reitz & Jens, Consulting Engineers, May 19, 1979.

h. Principal Spillway.

1. Type ... Uncontrolled, drop inlet, 4-foot square concrete riser
2. Location ... Right end of dam
3. Top ... Elevation 475.0
4. Bottom ... Elevation 466.1
5. Outlet ... 48-inch diameter corrugated metal pipe, length 47 feet

i. Emergency Spillway.

1. Type ... Uncontrolled, excavated earth, trapezoidal section
2. Location ... Left abutment
3. Crest ... Elevation 476.8
4. Approach channel ... Lake
5. Outlet channel ... V-section earth

j. Lake Drawdown Facility (Partial).

1. Type ... 6-Inch cast-iron pipe*
2. Control ... Gate valve
3. Location ... Drop inlet
4. Discharge ... Elevation 467.0±

*Per construction drawings by Reitz & Jens, Consulting Engineers, May 19, 1969.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

As previously stated, the original dam, a structure approximately 17 feet high impounding a lake of about 3 acres, was raised approximately 10 feet in 1969. No design information relative to the original dam, which was constructed sometime around 1935 by Henry Schlueter (deceased), a local farmer, is known to exist. Plans for raising the dam, reference Plates 6, 7 and 8, are included herein. With the exception of the data shown on the plans and some information obtained from one of the designers, Fred E. Palmerton, formerly with Reitz & Jens and now employed by Anderson Engineering, Inc. of Springfield, Missouri, no record of the design work is known to exist. According to Reitz & Jens, with the exception of these drawings, the file containing all correspondence, specifications, calculations, and other records was recently disposed of during relocation of their office.

According to John J. Bailey, Vice President, Reitz & Jens, a design for improving the dam was prepared by Soil Conservation Service (SCS) and, at the request of the Girl Scouts, Reitz & Jens, was invited to review the SCS design. Investigations by Mr. Palmerton indicated that a larger principal spillway than that recommended by SCS would require less frequent use of the emergency spillway outlet. The Girl Scouts accepted the Reitz & Jens design changes and the necessary construction plans for implementing the design were prepared. According to Mr. Bailey, the information shown on Sheet 1 of the plans was in part done by SCS, with all the detail shown with lower case lettering by SCS, and the detail shown with upper case lettering by Reitz & Jens. Since the embankment and the emergency spillway section is done in lower case lettering, it is presumed to have been specified by SCS. According to Richard E. McMillen, SCS District Conservationist, St. Louis County (Jefferson County does not have an SCS office, and the work done there is handled by the St. Louis County office), there are no records of this design in their files.

Mr. Palmerton reported that the 100-year frequency flood was the basis of the Reitz & Jens' design for the principal spillway, and that 1.5 or 2.0 feet of freeboard was provided between the 100-year design lake level and the crest of the emergency spillway. However, Mr. Palmerton could not recall the criteria used for determining or checking the proportions of the emergency spillway or the top of dam elevation. Mr. Palmerton indicated that he is of the opinion that, with the exception of revising the principal spillway, the remainder of the design, including the embankment requirements, was designated by SCS.

2.2 CONSTRUCTION

As previously indicated, the original dam was constructed about 1935 by Henry Schlueter, a local farmer. According to Ms. Amanda Schlueter, her father hand excavated a seepage cutoff trench approximately 18 inches wide to rock along the longitudinal axis of the dam and then filled the section with concrete. Ms. Schlueter also indicated that the embankment material used in the dam was placed using a mule drawn scraper. In 1969, in accordance with the details shown on the plans prepared by Reitz & Jens, the dam was raised approximately 10 feet. The contractor that performed the work indicated on the plans could not be determined. According to Mr. Palmerton, to the best of his knowledge, inspection of construction activities were handled by SCS.

2.3 OPERATION

The lake level is uncontrolled and governed by the elevation of the top of the drop inlet type spillway as well as the crest of the emergency spillway. No indication was found during the inspection that the dam has been overtopped. James LaPlant, Ranger and camp caretaker, reported that the dam has never been overtopped, and that the highest observed lake level was only about 0.3 foot above the drop inlet.

Mr. McMillen, SCS District Conservationist, recalled inspecting the dam several years ago, and that the only problem he observed at that time was the rather extensive erosion damage of the upstream face of the embankment.

2.4 EVALUATION

a. Availability. Seepage and stability analysis for assessing the design of the dam were unavailable. Recorded data available is limited to information shown on the construction plans prepared by Reitz & Jens, Inc., in 1969.

b. Adequacy. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. The information shown on the logs of the test borings may have to be supplemented by additional borings to obtain undisturbed samples of foundation materials for determination of necessary shear strengths to be utilized in the stability analyses.

According to hydrologic/hydraulic investigations performed under the direction of the inspection team, the spillways are capable of passing lake outflow corresponding to about 60 percent of the probable maximum flood inflow. Since spillway capacity exceeds the recommended spillway design flood, i.e. one-half the probable maximum flood, no further hydrologic/hydraulic investigations are considered necessary.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Atwood Lake Dam was made by Horner & Shifrin engineering personnel, R. E. Southoff, Civil Engineer, H. B. Lockett, Hydrologist, and A. B. Becker, Jr., Civil and Soils Engineer, on 8 October 1980. An examination of the dam area was also made by an engineering geologist, Jerry D. Higgins, Ph.D., a consultant retained by Horner & Shifrin for the purpose of assessing the site geology. Also examined at the time of the inspection were the areas and features below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on pages A-1 through A-4 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 3.

b. Site Geology. Atwood Lake is located in a steep-walled valley on the north side of Sand Ridge, and is a tributary to Sandy Creek. The topography around the lake site is moderately rugged with low cliffs forming some valley walls. Relief between the valley floor and surrounding drainage divides ranges up to a maximum of approximately 290 feet. The area is included within the northeastern part of the Ozark Plateaus Physiographic Province, and the regional dip of the bedrock is to the northeast.

The bedrock at the site consists of Ordovician-age sandstones and dolomites of the St. Peter and Joachim formations. The lake is located on the St. Peter sandstone with the Joachim dolomite exposed approximately 25 feet above the crest of the dam. The St. Peter formation is exposed in a steep bluff which forms the south shore of the lake. No faulting was observed in the immediate vicinity of the lake.

The St. Peter formation is a white, fine- to medium-grained, pure quartz sandstone. It generally is massively bedded and, although loosely cemented, exposed rock surfaces usually are case-hardened by weathering processes. The sandstones are permeable and will transmit water readily. Reservoir leakage is a common problem if a sufficient soil cover is not left on the reservoir floor. The Joachim formation is composed primarily of a yellowish-brown, argillaceous dolomite. Interbedded limestone and shale are present in the lower part of the formation. The dolomites are extensively jointed and have undergone considerable solution weathering, causing the permeability of the bedrock to be high. Sinkholes, caves, and springs are common in this formation, although none were observed at the lake site.

The soils at the site are of two types. Slopes above the reservoir are covered with a thin, stony residual soil (CL, Unified Soil Classification System) derived from weathering of the dolomite bedrock. The soil around the shoreline consists of a mixture of sandy residuum from the St. Peter sandstone and colluvium from the upper slopes. The resulting soil is a sandy, stony clay (ML-CL range). The lake is located on permeable bedrock; however, leakage reportedly is not a problem. The soils do not appear to be permeable and are of sufficient thickness to retard movement of water to bedrock. However, these soils are susceptible to erosion.

The most significant geologic conditions at the site are the permeable bedrock forming the valley floor and the erodibility of the soils. The soil deposits appear to be sufficiently thick enough to prohibit excessive water loss from the lake. No other geologic conditions were observed that would adversely affect the performance or stability of the dam embankment.

c. Dam. The visible portions of the upstream and downstream faces as well as the dam crest (see Photo 1, 2 and 3) were examined and found to be in sound condition, although erosion that appeared to be due to wave action and/or fluctuations of the lake level had created a steep, and in some places a near vertical bank about 30 inches high along almost the entire unprotected (no riprap) upstream face of the dam. Sloughing of the slope extending from the waterline to the dam crest (see Photo 10) was observed in the vicinity of station 0+50±. Some minor surface cracking, about 3 inches deep and up to 6 inches in length, was also noticed along the upstream face near the top of the slope. Patches of dense undergrowth and several small trees (see Photo 11) were found throughout the entire downstream face of the dam, and although it was later reported by Mr. LaPlant, Camp Ranger, that several groundhog dens existed in the downstream side of the dam, no animal burrows were found during the inspection. It is very likely that the dense undergrowth on the downstream face of the dam prevented notice of these burrows. No undue settlement of the dam crest, sloughing of the downstream slope, or erosion of the embankment at the abutments was noted. Some standing water was noticed within the original stream channel just downstream of the principal spillway outlet; however, it could not be determined if the flow was seepage from the lake or ground water exiting the hillside of the right abutment; in any event, the quantity was minor and not considered to be of significance. The grass on the dam crest, a combination of clover and fescue, had recently been mowed; elsewhere, the grass, a combination of lespedeza, native grasses, and weeds, was on the order of 3 feet high. Examination of a soil sample obtained from the downstream side of the embankment near the center of the dam, indicated the surficial material of the dam to be a reddish-brown lean clay (CL) of medium plasticity.

The drop inlet spillway structure (see Photo 4) was examined and found to be in satisfactory condition. No cracking or significant deterioration of the concrete structure was noticed. Except for a light coating of rust on the surface, the steel reinforcing bar type trash rack on the top of the inlet appeared to be in reasonably good condition. As far as could be determined, the lake drawdown pipe cast-iron gate valve (see Photo 9) also appeared to be in satisfactory condition, although it was not operated to check its capability. The 48-inch corrugated metal pipe that serves as an outlet for the drop inlet, including the concrete headwall structure at the downstream end of the pipe (see Photo 5), was inspected and no significant defects were noticed, although some drainage was trapped within the pipe. According to survey data obtained during the inspection, the elevation of the channel just downstream of the pipe was about 0.6 foot higher than the end of the pipe which would account for the standing water within the pipe. As far as could be determined, the bituminous coating on the interior of the pipe appeared to be intact. The outlet channel just downstream of the pipe (see Photo 6) was inspected and found to be in good condition with no indication of significant erosion of the earth and sandstone invert.

The emergency spillway (see Photo 7) and outlet channel (see Photo 8) were inspected and found to be in satisfactory condition, although erosion had created a gulley approximately 5 feet wide and 3 feet deep within the channel beginning at a point about 75 feet downstream of the spillway crest. Since it was reported that the lake has not overflowed the emergency spillway crest, the erosion was apparently due to overland drainage. Logs had been placed in the gulley (see Photo 12) in order to prevent further erosion. It did not appear that the eroded area was near enough to the dam at this time to affect the stability of the slope.

d. Appurtenant Structures. No appurtenant structures were observed at this dam site.

e. Downstream Channel. Except for the culvert crossing at Sandy Road, the channel downstream of the dam within the potential flood damage zone is unimproved. The channel section is irregular and for the most part, lined with trees. A small nearly dried up lake, Cedar Lake as identified on the Watershed Map, Plate 2, lies along the course of the channel approximately 2,000 feet downstream of the dam. The stream joins Sandy Creek about one mile downstream of the impoundment.

f. Reservoir. Except for a narrow, grass-covered area on the north side of the lake where a roadway that serves to access the lake and dam is located, the hillsides contingent to the reservoir are covered with trees. No significant erosion of the lake banks was observed. At the time of the inspection, the lake was about 0.4 foot below normal pool level and the water within the reservoir was clear. The amount of sediment within the lake could not be determined at the time of the inspection; however, due to the vegetation covering the surrounding area and the fact that the general area adjacent to the lake appeared to be well maintained, it is not expected to be significant.

3.2 EVALUATION

The deficiencies observed during the inspection and noted herein are not considered significant to warrant immediate remedial action. However, it is recommended that, as soon as practical, the eroded areas of the upstream face of the dam be restored and some durable form of protection be provided in order to prevent future erosion.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways are uncontrolled. The lake surface level is governed by precipitation runoff, evaporation, seepage, and the capacities of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

According to James E. LaPlant, Ranger and camp caretaker, the dam receives some maintenance, such as periodic cutting of the grass on the dam crest through the growing season and the removal, about 3 years ago, of the larger trees from the downstream face of the dam. Mr. LaPlant also reported that groundhog holes exist in the downstream face of the dam and that several holes, believed to be muskrat burrows, have been observed along the upstream face of the dam. According to Mr. LaPlant, the dam has been experiencing erosion problems along the upstream face of the embankment for a number of years, and the eroded area within the emergency spillway outlet channel occurred from stormwater runoff.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

With the exception of the valve on the lake drawdown pipe, no outlet facilities requiring operation exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection did not reveal the existence of a dam failure warning system.

4.5 EVALUATION

It is recommended that maintenance of the dam also include periodic cutting of grass on the downstream face of the dam, restoration of the dam along the upstream face, and provision of a suitable form of protection (not grass) along the upstream slope in order to prevent erosion by wave action or by fluctuations of the lake level. Steps should be taken to rid the dam of burrowing animals as well as the dense undergrowth that conceals their burrows. Provision should also be taken to restore the eroded areas of the emergency spillway outlet channel and to provide some durable form of protection to prevent future erosion of the channel by spillway flows or overland drainage. Trees on the dam should be removed since tree roots, as well as animal burrows, can provide passageways for lake seepage that can lead to a piping condition and failure of the dam. It is also recommended that a detailed inspection of the dam be instituted on a regular basis by an engineer experienced in the design and construction of dams and that records be kept of all inspections made and remedial measures taken.

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available.

b. Experience Data. The drainage area and lake surface area were developed from the 1954 USGS Herculaneum, Missouri, Quadrangle Map (photorevised 1968 and 1974). The proportions and dimensions of the spillways and dam were developed from surveys made during the inspection. Records of rainfall, streamflow or flood data for the wastershed are not available.

Due to the fact that the watershed for this reservoir is small and since there is no history of excessive reservoir leakage that would adversely affect the normal operating level of the lake, the lake level was assumed to be at normal pool as a result of antecedent storms prior to occurrence of the PMF and the probabilistic storm.

According to the St. Louis District, Corps of Engineers, the estimated flood damage zone, should failure of the dam occur, extends one mile downstream of the dam.

c. Visual Observations.

1. The principal spillway, a 48-inch square reinforced concrete drop inlet with a concrete backwall, is located near the right, or south, abutment of the dam. The drop inlet is about 8.9 feet deep. A reinforcing bar grating with a six-inch mesh over the top of the inlet serves as a trash screen. (Due to the fact that the camp property, including the dam, is maintained by a full time caretaker that resides on the premises, and since there is no history of clogging of the trash screen, no allowance in capacity for blockage of the principal spillway by lake carried debris was made.)

2. A 48-inch corrugated metal pipe extends from the drop inlet to a concrete headwall about 31 feet downstream of the centerline of the dam. The outlet channel extends about 63 feet beyond the headwall and terminates in an abrupt drop.

3. The emergency spillway, an excavated earth, broad-crested trapezoidal section, is located in the hillside of the left, or north, abutment. This spillway has a vegetative type of cover.

4. The emergency spillway outlet channel, a shallow V-section, extends southwardly adjacent to the downstream toe of the dam and joins the original stream channel about 40 feet downstream of the dam.

d. Overtopping Potential. The spillways (principal plus emergency) are inadequate to pass the probable maximum flood without overtopping the dam. The spillways are considered incapable of passing one-half the probable maximum flood withough significant degradation of the emergency spillway crest by lake outflow. The spillways are adequate, however, to pass the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of the dam overtopping analysis are as follows:

(Note: The data appearing in the following table has been extracted from the computer output data appearing in Appendix B. Decimal values have been rounded to the nearest one-tenth in order to prevent assumption of unwarranted accuracy.)

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Effective Top of Dam (Elev. 478.8)	Duration of Overtopping of Dam (Hrs.)
0.50	504	479.2	0.4	0.4
1.00	1,994	480.8	2.0	1.3
1% Probability Flood	135	477.1	0.0	0.0

Elevation 478.8 was considered to be the effective top of dam elevation. With the lake level at elevation 478.8, the peak velocity of lake outflow within the emergency spillway is 6.0 feet per second, and the assumed permissible (non-erosive) velocity of 5.0 feet per second is exceeded for approximately 0.9 hour, which is considered acceptable. The maximum flow

safely passing the spillway just prior to the lake level reaching the effective top of dam elevation, was determined to be approximately 403 cfs, which is the routed outflow corresponding to about 42 percent of the probable maximum flood inflow.

e. Evaluation. Experience with embankments constructed of similar material (a lean clay of medium plasticity) to that used to construct this dam have shown evidence that the material, under certain conditions such as high velocity flow, can be very erodible. Such a condition exists during the PMF when large lake outflow, accompanied by high flow velocities, occurs. For the PMF condition, both the effective top of dam (elevation 478.8) and the actual top of dam (elevation 479.8) were found to be overtopped. For the one-half PMF condition, only the effective top of dam was found to be exceeded. Damage by erosion of the dam and/or emergency spillway is expected during occurrence of the one-half PMF and PMF events. The extent of these damages is not predictable within the scope of these investigations; however, there is a possibility, particularly during the PMF, that they could result in failure by erosion of the dam.

f. Reference. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing the spillways and dam crest are presented on pages B-1 through B-3 of the Appendix. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood and the 100-year frequency flood are shown on pages B-4 through B-6. Computer output data, including unit hydrograph ordinates, tabulation of PMF rainfall, loss and inflow data are shown on pages B-7 through B-10; tabulation of lake surface area, elevation and storage volume is shown on page B-11 and tabulations titled "Summary of Dam Safety Analysis" for the PMF and 1 percent chance (100-year frequency) flood are also shown on page B-11.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1c.

b. Design and Construction Data. With the exception of the test boring logs shown on the construction plans, reference Plate 6, no design or construction data relating to the structural stability of the dam were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Operating Records. Except for the valve on the lake drawdown pipe, no appurtenant structures or facilities requiring operation exist at this dam. According to Mr. James E. LaPlant, Ranger and camp caretaker, no records of the lake level, spillway discharge, dam settlement, or lake seepage are kept.

d. Post Construction Changes. As previously stated, the dam was originally constructed sometime about 1935 and raised approximately 10 feet to its present height in 1969. The existing drop inlet spillway and emergency spillway were provided when the dam was raised. According to Mr. LaPlant, no post construction changes have been made or have occured since 1969 which would affect the structural stability of the dam. A possible exception is the erosion that has occurred along the upstream face of the dam.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillways are capable of passing lake outflow of about 663 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicates that for storm runoff of one-half probable maximum flood magnitude, the recommended spillway design flood, the lake outflow would be about 504 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 135 cfs.

Seepage and stability analyses of the dam were not available for review, and therefore, no judgment could be made with respect to the structural stability of the dam.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include erosion of the upstream face of the dam, trees and areas of dense undergrowth on the downstream face of the embankment and erosion of the emergency spillway outlet channel. Animal burrows were not observed during the inspection, but their presence was indicated by Mr. LaPlant, the camp caretaker.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based largely on external conditions as determined during the visual inspection. The assessments of the hydrology of the watershed and capacity of the spillways were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 for the items concerning the safety of the dam noted in paragraph 7.1a should be accomplished within the near future. Restoration and protection of the upstream face of the dam should be assigned a high priority.

d. <u>Necessity for Phase II.</u> Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. <u>Seismic Stability.</u> The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

a. <u>Recommendations.</u> The following action is recommended:

(1) Provide a durable form of protection at the emergency spillway in order to prevent erosion of the spillway by lake outflow resulting from a storm of one-half probable maximum flood magnitude, the recommended spillway design flood for this dam.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of earthen dams.

b. <u>Operations and Maintenance (O & M) Procedures.</u> The following O & M procedures are recommended:

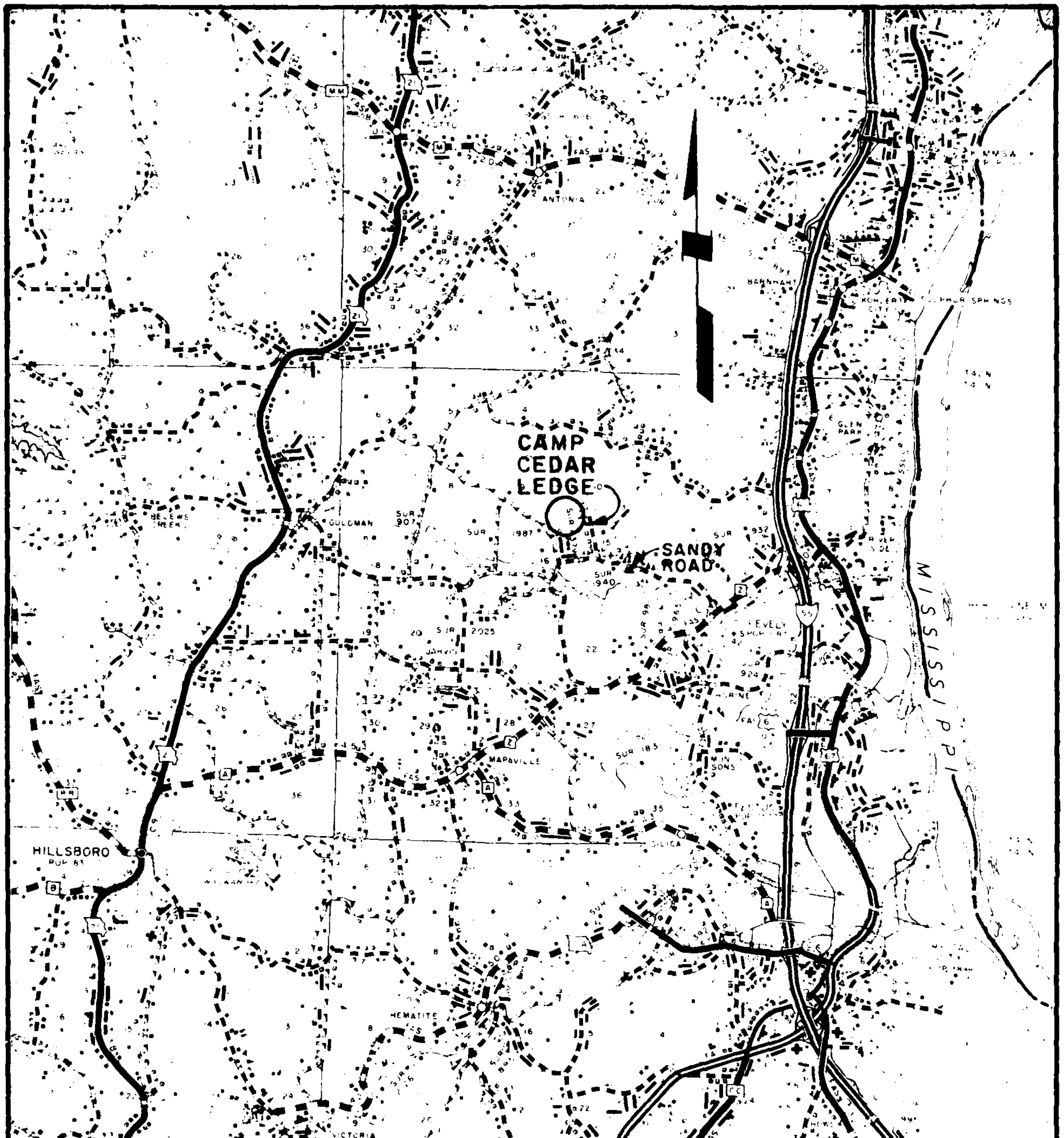
(1) Restore the eroded areas of the upstream face of the dam and provide some form of protection, other than grass, in order to prevent future erosion of the embankment by wave action or by fluctuations of the lake level. Loss of embankment material due to erosion can impair the structural stability of the dam.

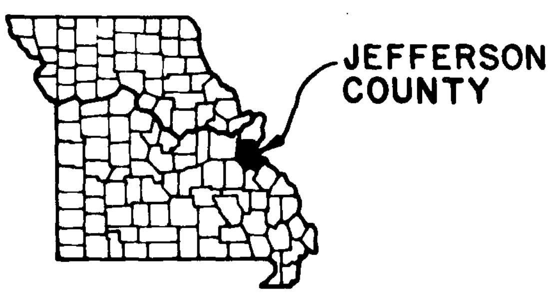
(2) Remove the trees and the undergrowth that can conceal animal burrows from the downstream face of the dam. Rid the dam of burrowing animals and restore the dam at all holes with compacted impervious material (clay). Tree roots and animal burrows can provide passageways for lake seepage that can develop into a piping condition (progressive internal erosion) which can lead to failure of the dam.

(3) Restore the eroded area of the emergency spillway outlet channel and provide some durable form of protection to prevent future erosion by lake outflow and/or storm water runoff. Although not considered serious enough at this time to jeopardize the stability of the dam, it is possible that continued erosion of the channel could affect the dam and allow spillway releases and/or overland drainage to encroach upon the dam, resulting in loss of embankment material by erosion and conditions unfavorable to the stability of the dam.

(4) Provide maintenance of all areas of the dam on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(5) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.





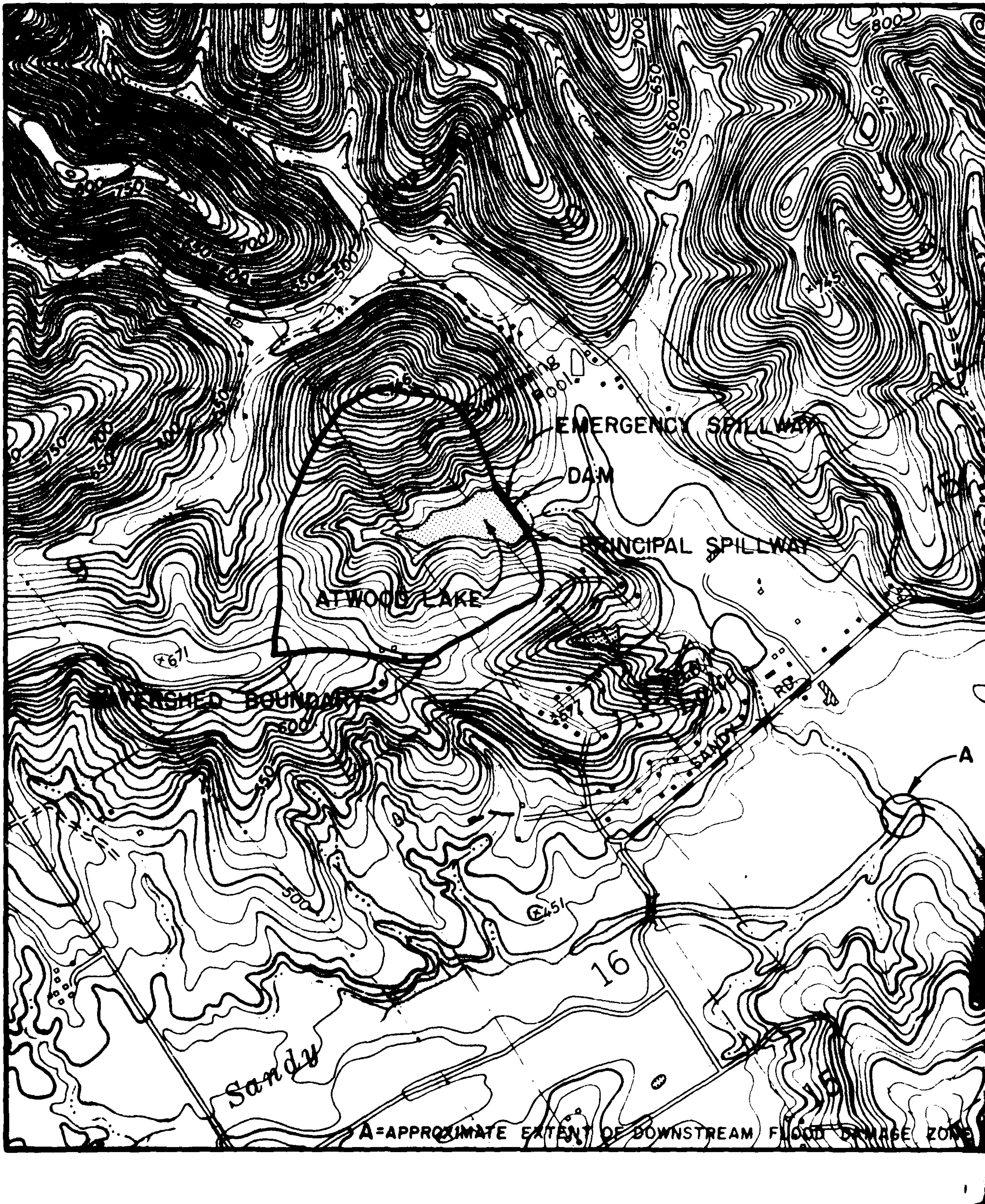
LOCATION MAP

CAMP CEDAR LEDGE
(ATWOOD LAKE)

SCALE (MILES)

REGIONAL VICINITY MAP

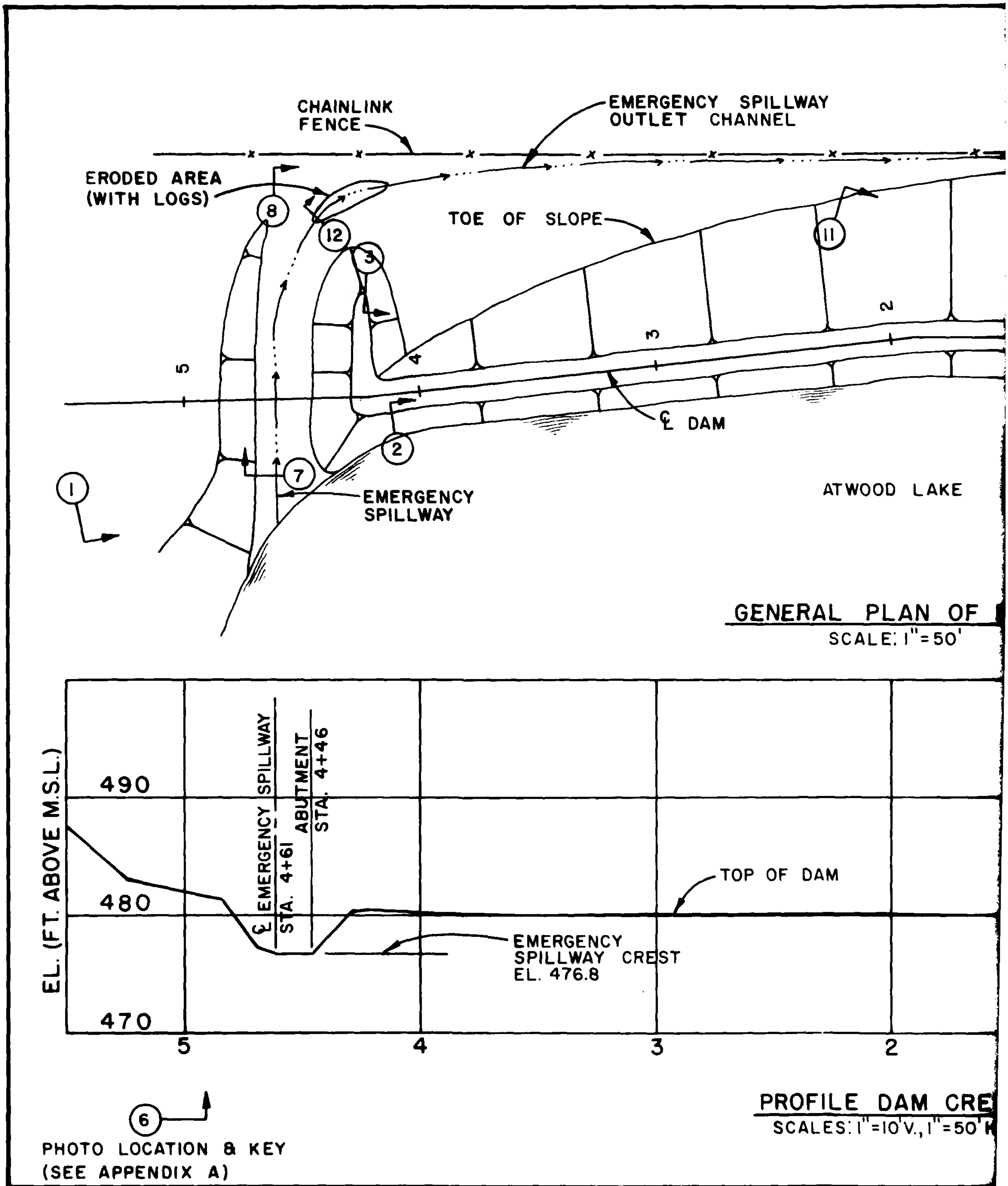
PLATE I

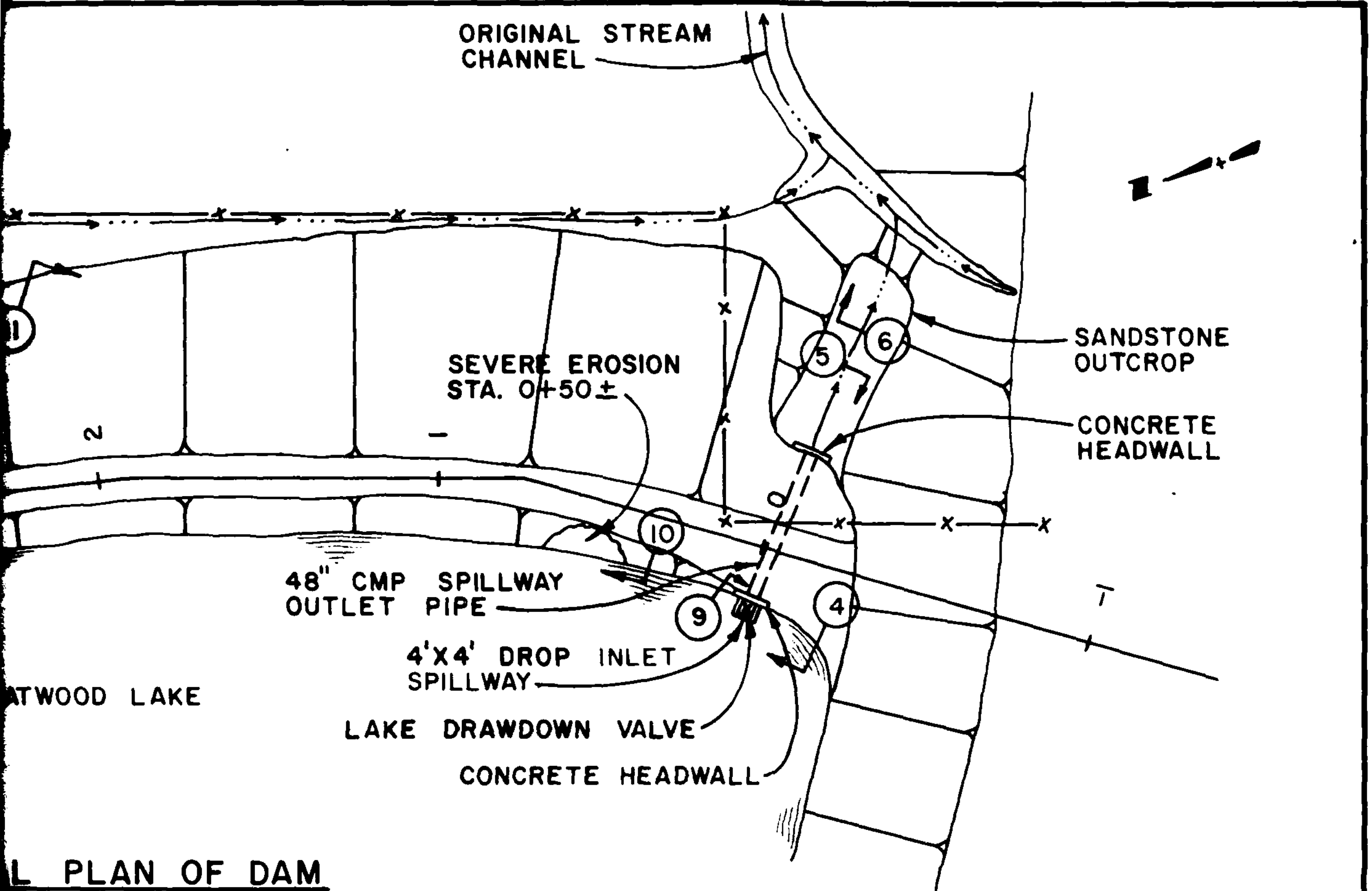

EMERGENCY SPILLWAY
DAM
PRINCIPAL SPILLWAY
ATWOOD LAKE
WATERSHED BOUNDARY
SANDY RD.
Sandy
16
A
A=APPROXIMATE EXTENT OF DOWNSTREAM FLOOD DAMAGE ZONE

Indian Foot Lake
Creek
A
ATWOOD LAKE
0 1000 2000 3000
SCALE IN FEET
(CONTOUR INTERVAL 10 FEET)
LAKE WATERSHED MAP

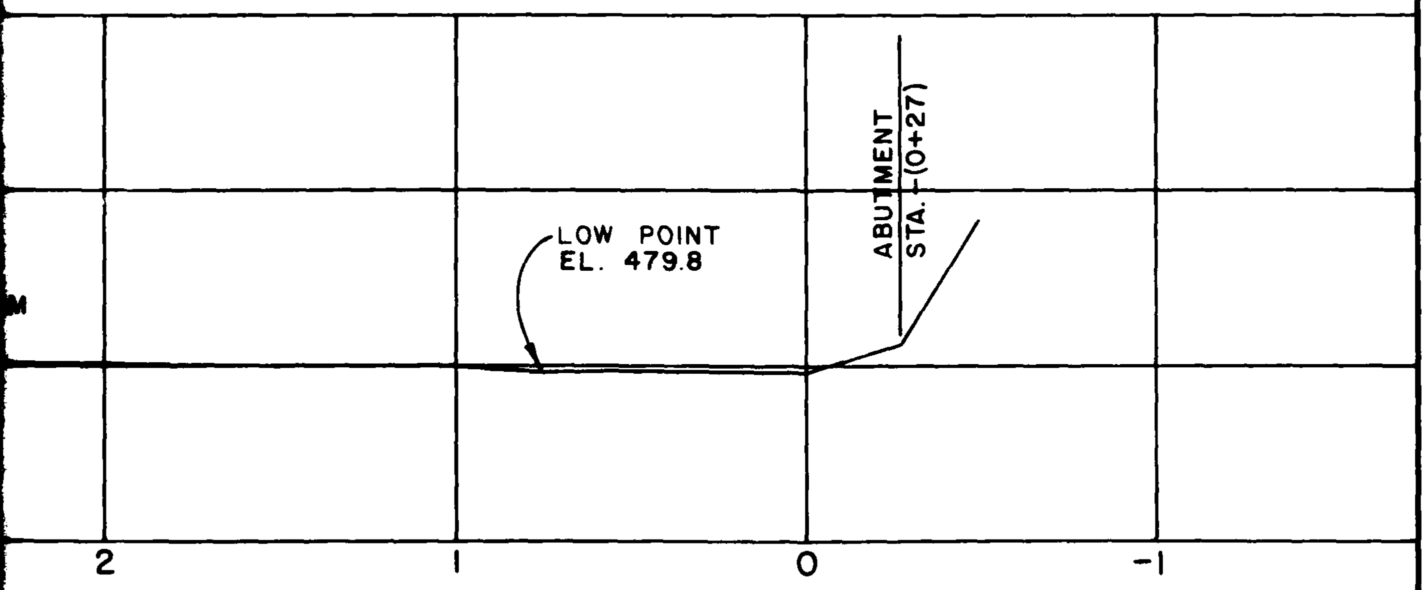
, 2

PLATE 2


CHAINLINK FENCE
EMERGENCY SPILLWAY OUTLET CHANNEL
ERODED AREA (WITH LOGS)
TOE OF SLOPE
℄ DAM
EMERGENCY SPILLWAY
ATWOOD LAKE
GENERAL PLAN OF
SCALE: 1"=50'
EL. (FT. ABOVE M.S.L.)
490
480
470
℄ EMERGENCY SPILLWAY
STA. 4+61
ABUTMENT
STA. 4+46
TOP OF DAM
EMERGENCY
SPILLWAY CREST
EL. 476.8
5
4
3
2
PROFILE DAM CRE
SCALES: 1"=10'V., 1"=50'H
PHOTO LOCATION & KEY
(SEE APPENDIX A)



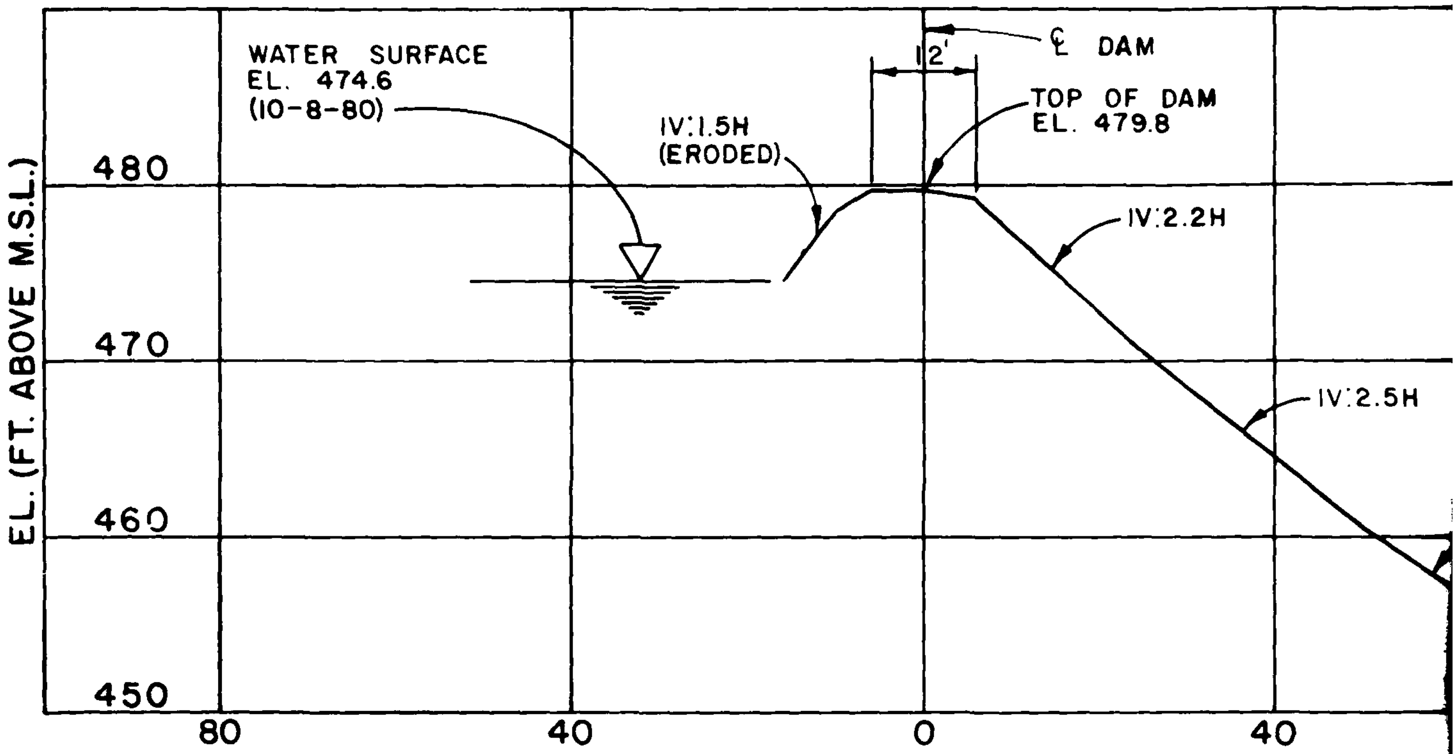
L PLAN OF DAM
SCALE: 1"=50'



LE DAM CREST
ES: 1"=10'V., 1"=50'H.

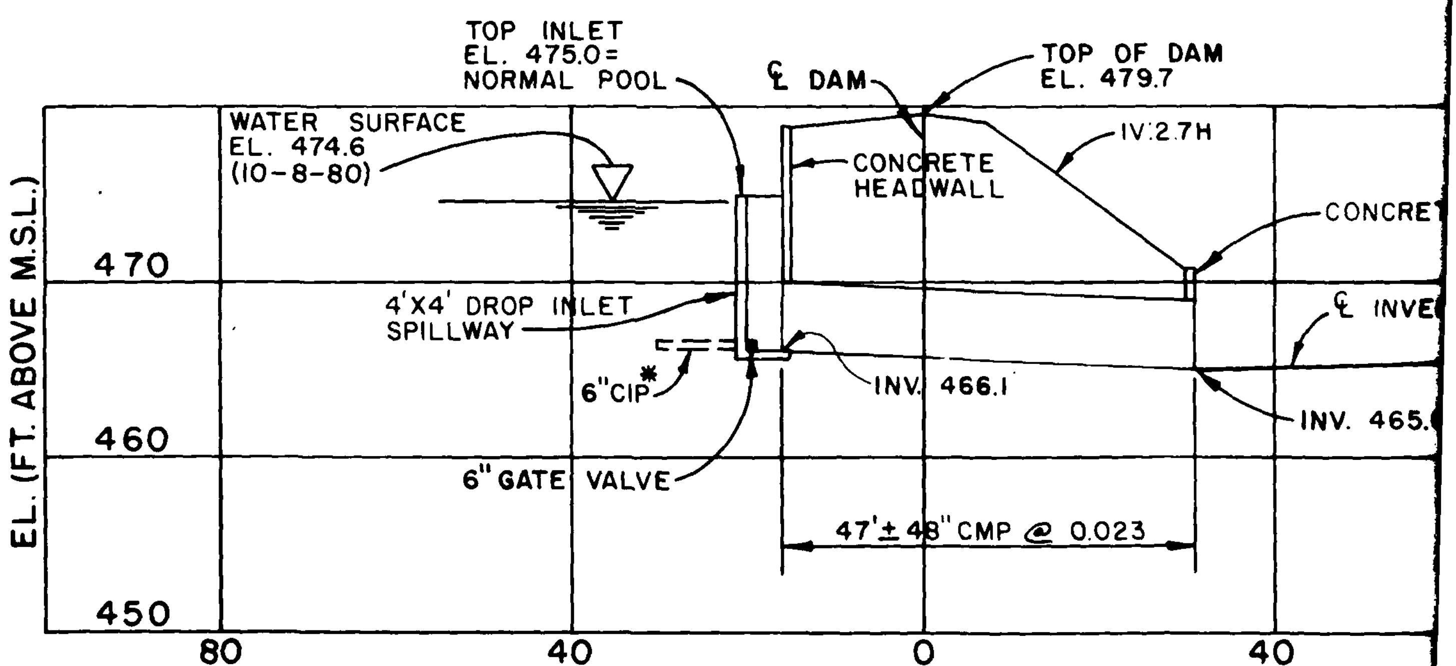
ATWOOD LAKE DAM PLAN & PROFILE
Horner & Shifrin, Inc. Oct. 1980

PLATE 3



DAM CROSS-SECTION STA. 0+75

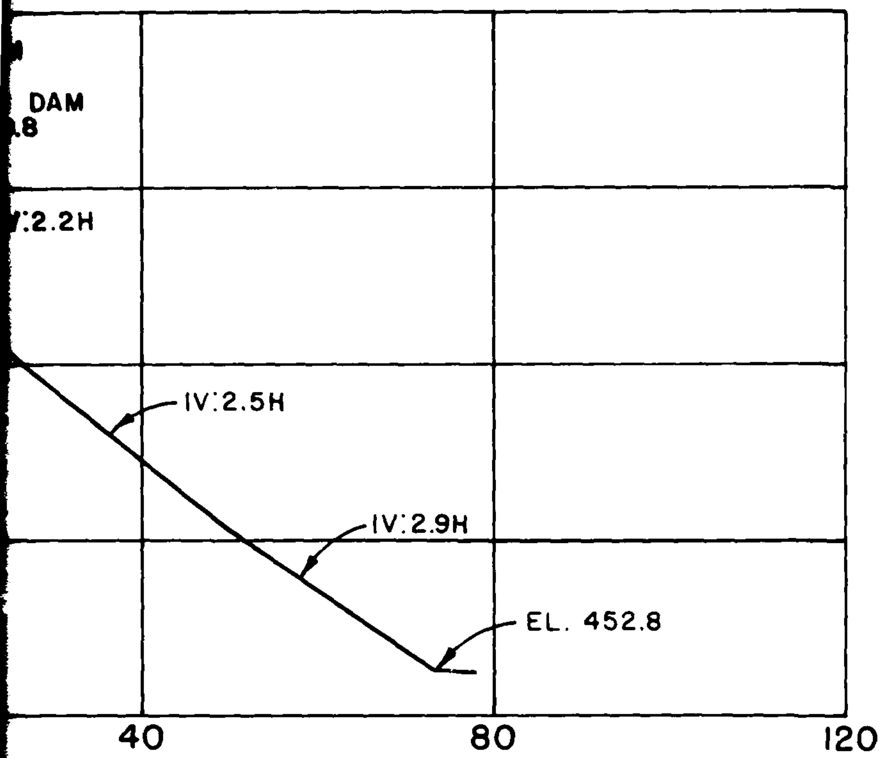
SCALES: 1"=10'V., 1"=20'H.



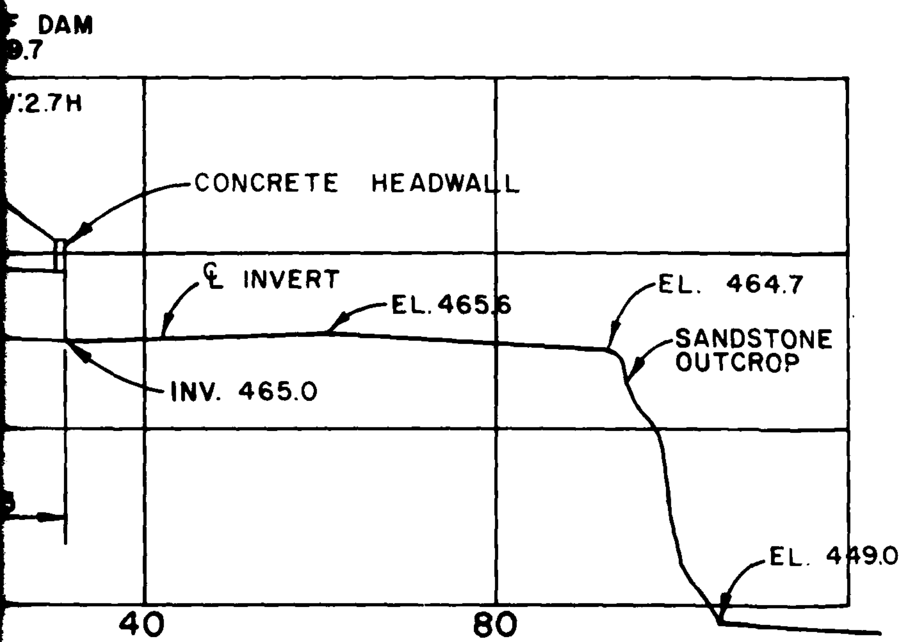
PROFILE PRINCIPAL SPILLWAY

SCALES: 1"=10'V., 1"=20'H.

*PER CONST. DWG.
BY REITZ & JENS



ON STA. 0+75
V., 1"=20' H.

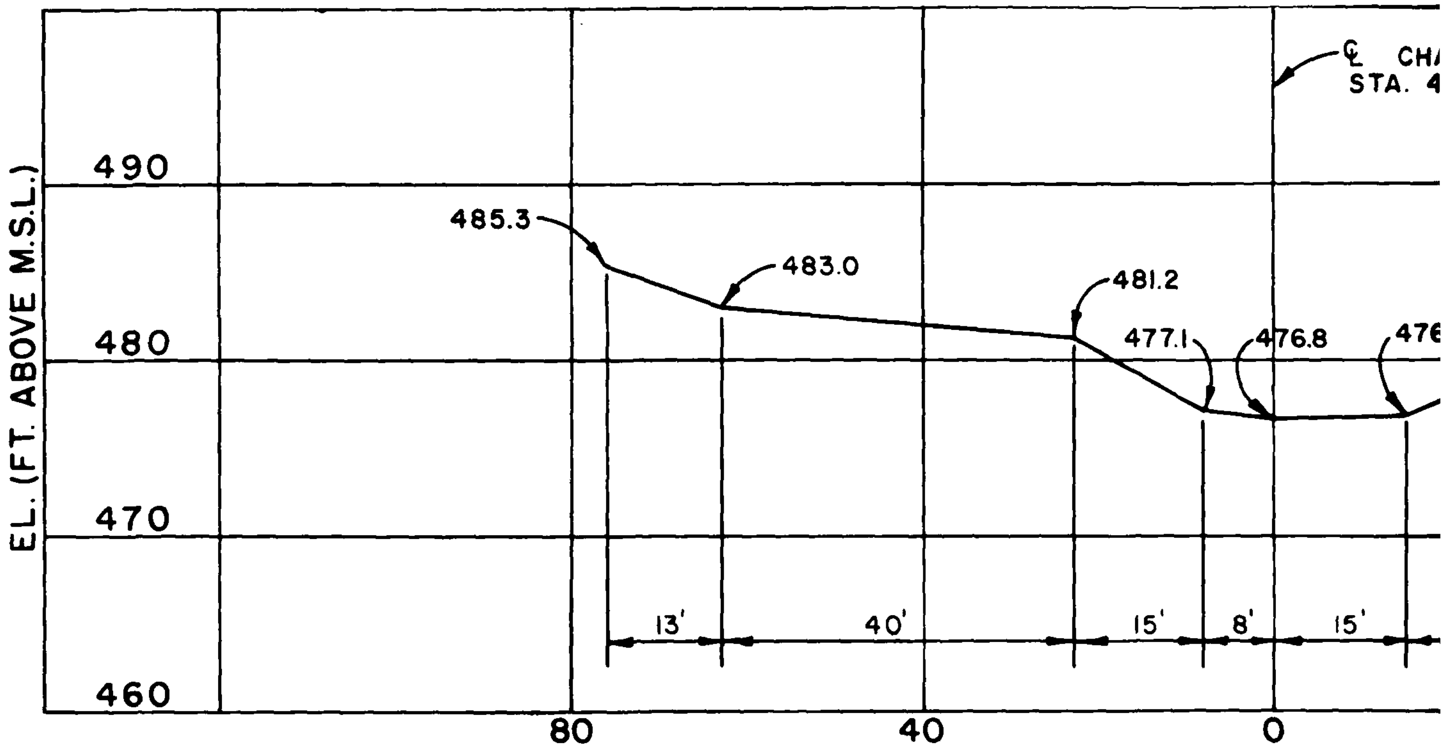


PAL SPILLWAY
., 1"=20' H.

ATWOOD LAKE
DAM CROSS-SECTION &
SPILLWAY PROFILE
Horner & Shifrin, Inc. Oct. 1980

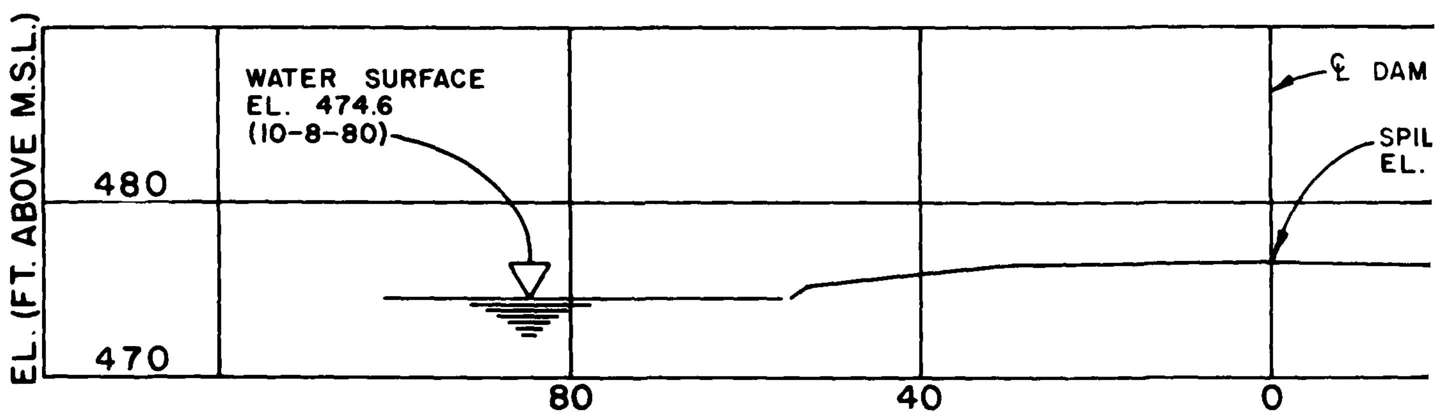
2

PLATE 4



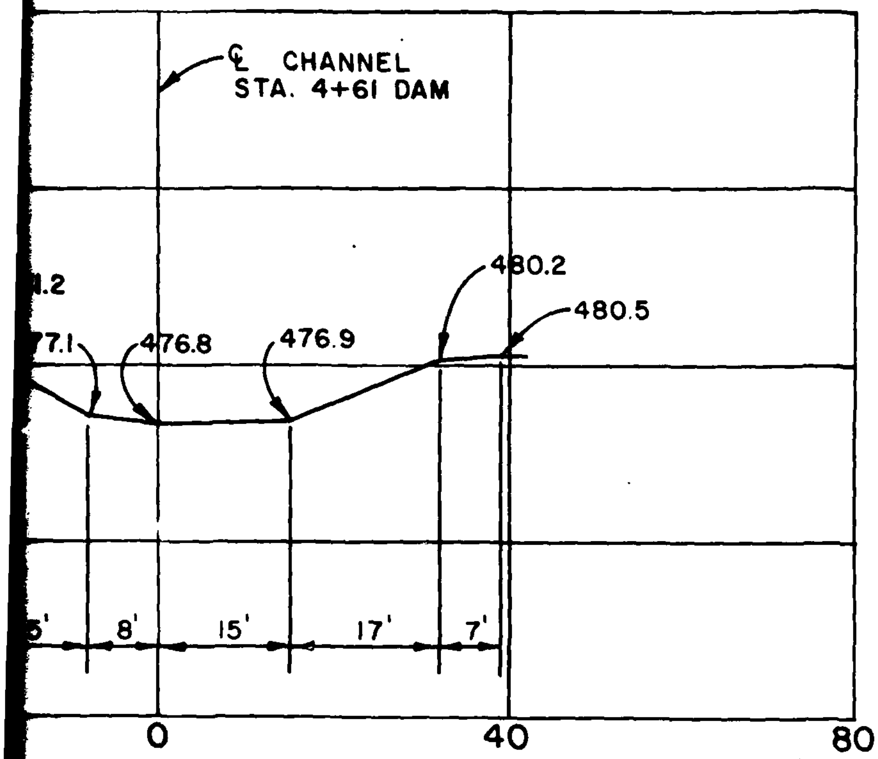
EMERGENCY SPILLWAY CROSS-SECTION – ℄

SCALE: 1"=10'V., 1"=20'H.

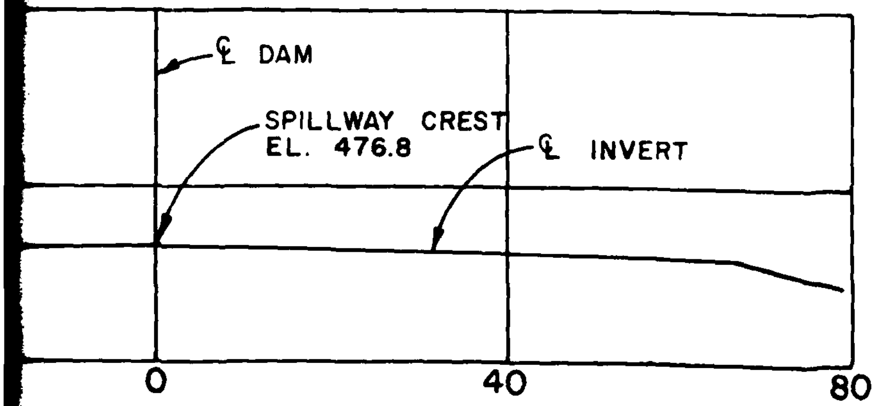


EMERGENCY SPILLWAY PROFILE

SCALE: 1"=10'V., 1"=20'H.



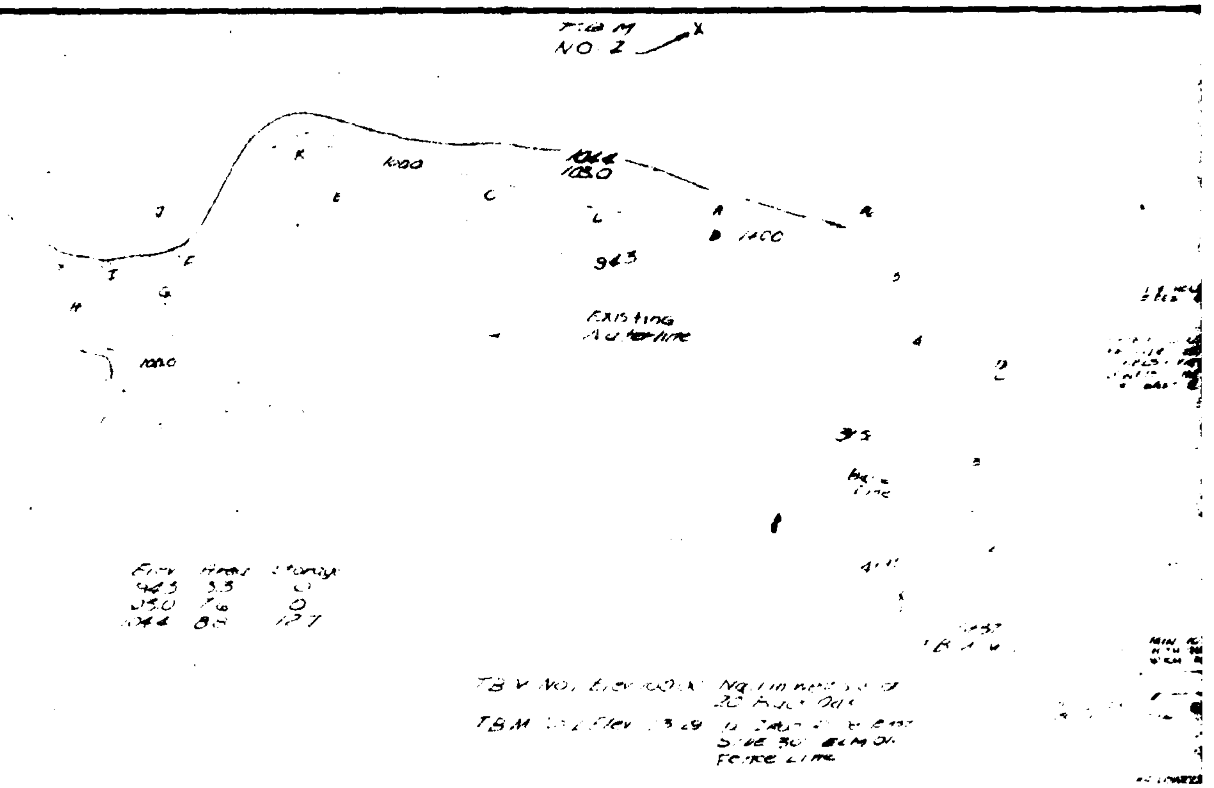
OSS-SECTION – ℄ DAM
., 1"=20'H.



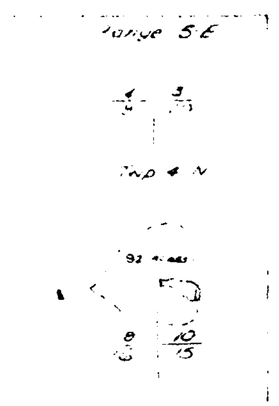
WAY PROFILE
, 1"=20'H.

ATWOOD LAKE
EMERGENCY SPILLWAY
CROSS-SECTION & PROFILE
Horner & Shifrin, Inc. Oct. 1980

PLATE 5

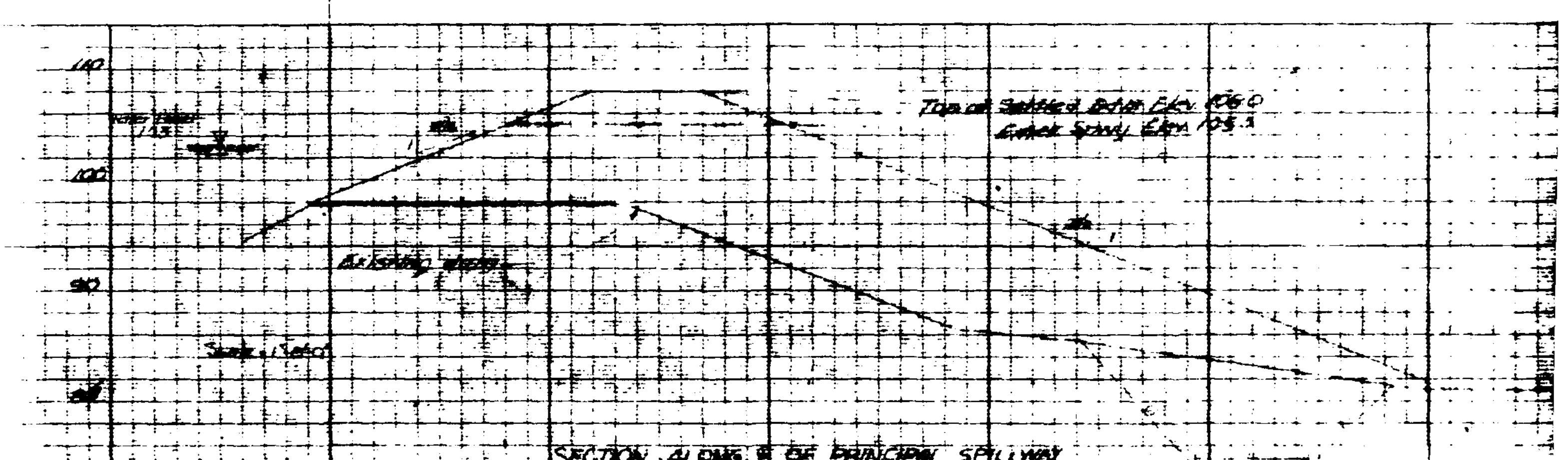


GENERAL PLAN OF RESERVOIR

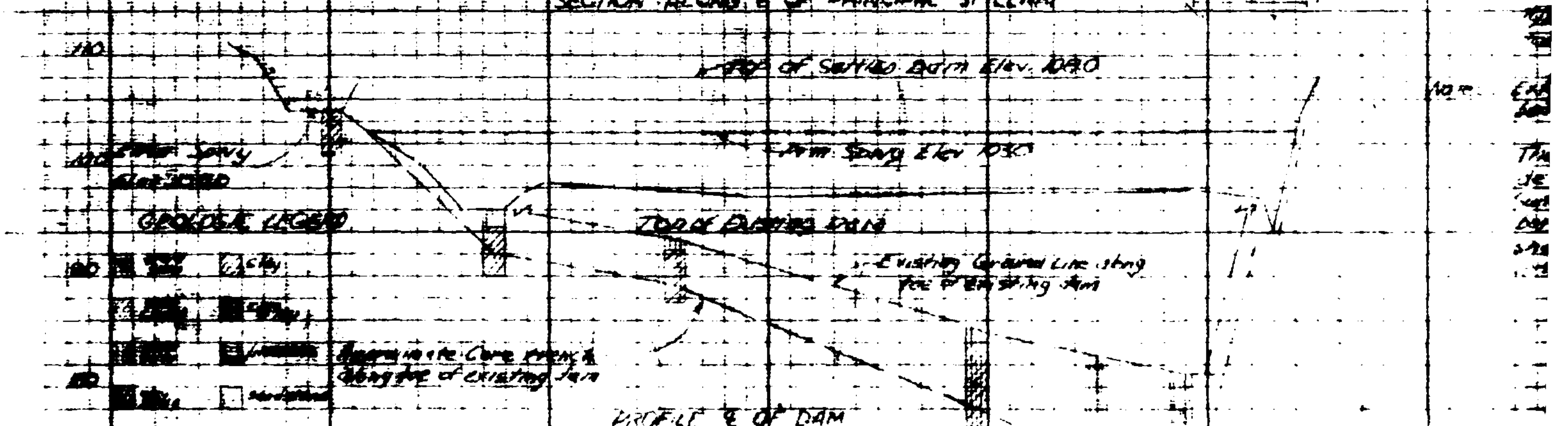


WATERSHED MAP

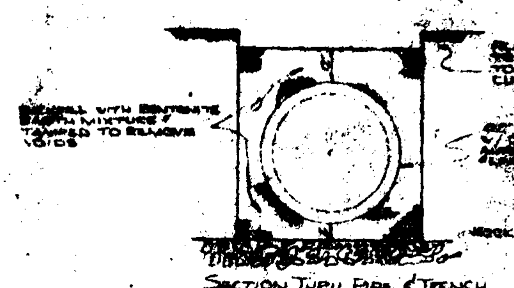
Scale 1" = 2000'



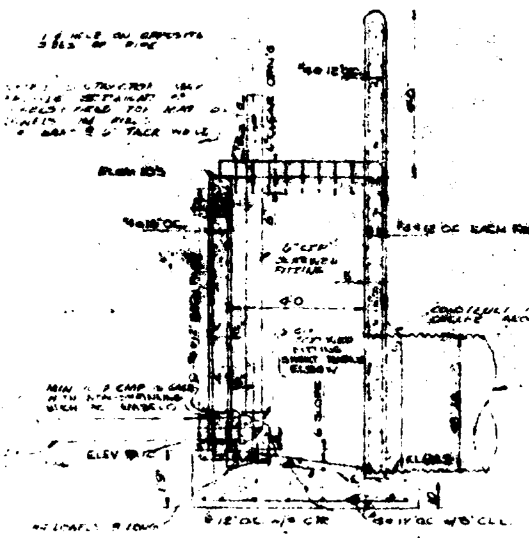
SECTION ALONG ℄ OF PRINCIPAL SPILLWAY



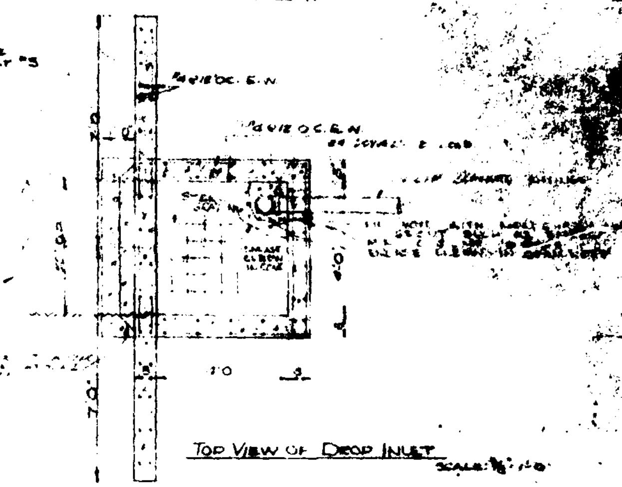
PROFILE ℄ OF DAM



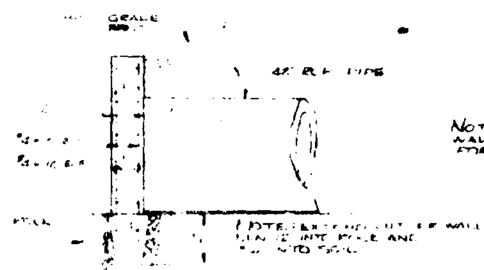
SECTION THRU PIPE & TRENCH
SCALE ½" = 1'-0"



SECTION THRU DROP INLET
SCALE ⅜" = 1'-0"



TOP VIEW OF DROP INLET
SCALE ⅜" = 1'-0"



NOTE: SECTION OF CUTOFF WALL IN RIDGE IS NOT PREPARED

SECTION THRU CUTOFF WALL

Note: Extend core trench into impervious strata or bedrock as directed by the engineer.

The pool shall be drained ... Suitable excavation shall be used for borrow. Unsuitable material shall be wasted as directed by the engineer.

NOTE: APPROX. VOLUME OF FILL IN LAKE EXCLUDING CORE TRENCH 1200 CU.YD.

IMPROVEMENT ON EXISTING LAKE
CAMP CEDAR LEDGE
JEFFERSON CO. MISSOURI

GIRL SCOUTS COUNCIL OF GREATER ST. LOUIS

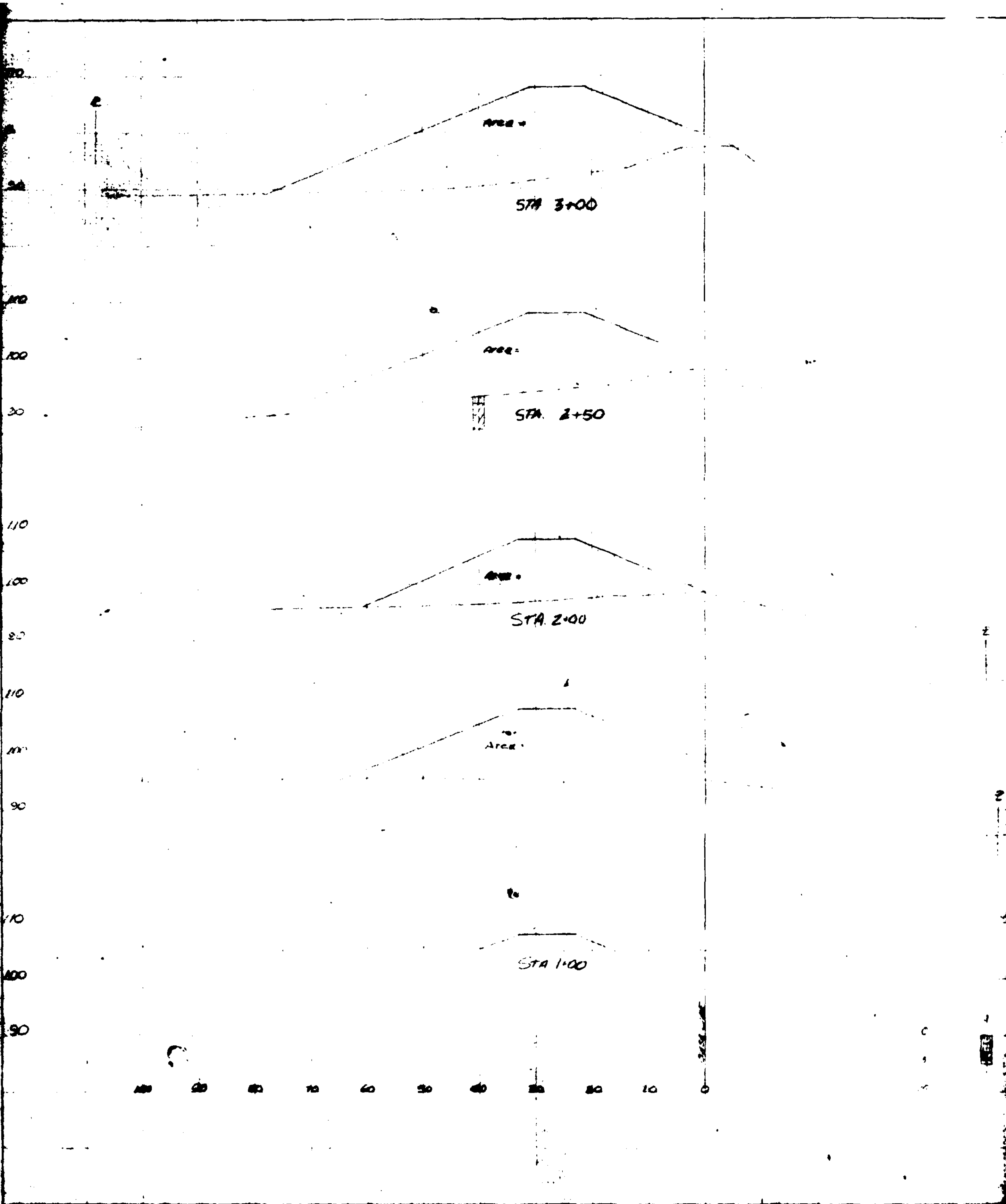
SITE PLAT

REVISION: 7-22-69
ISSUE DATE: 5-19-69
DESIGNED BY: F.E.P.
DRAWN BY: D.J.F.
CHECKED BY:

REITZ & JENS, CONSULTING ENGINEERS, ST. LOUIS, MISSOURI

SHEET 1 OF 3

PLATE 6


STA 3+00
Area =
STA. 2+50
Area =
STA. 2+00
Area =
STA 1+00
Area =
110
100
90
100
90
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60
50
40
30
20
10
0

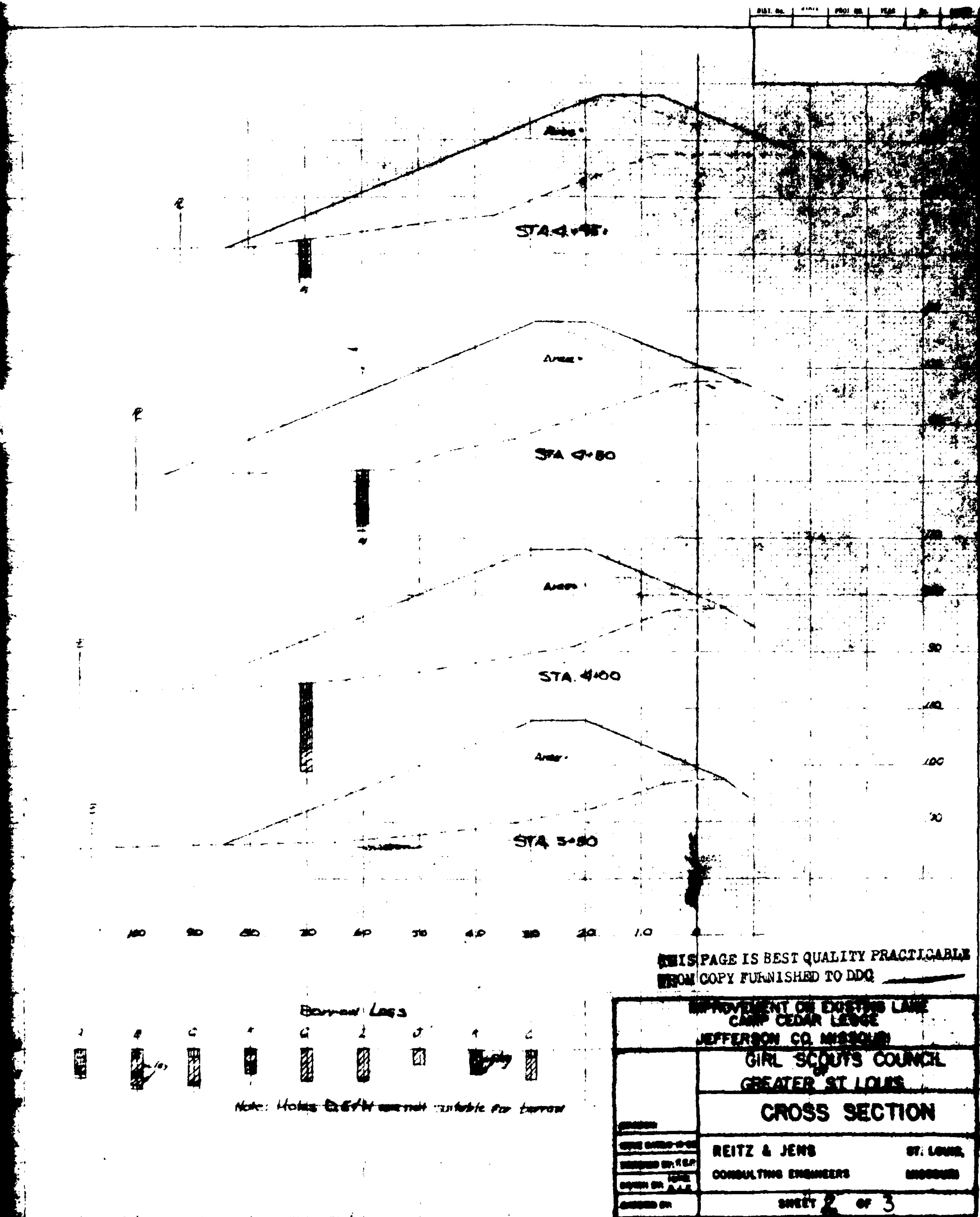
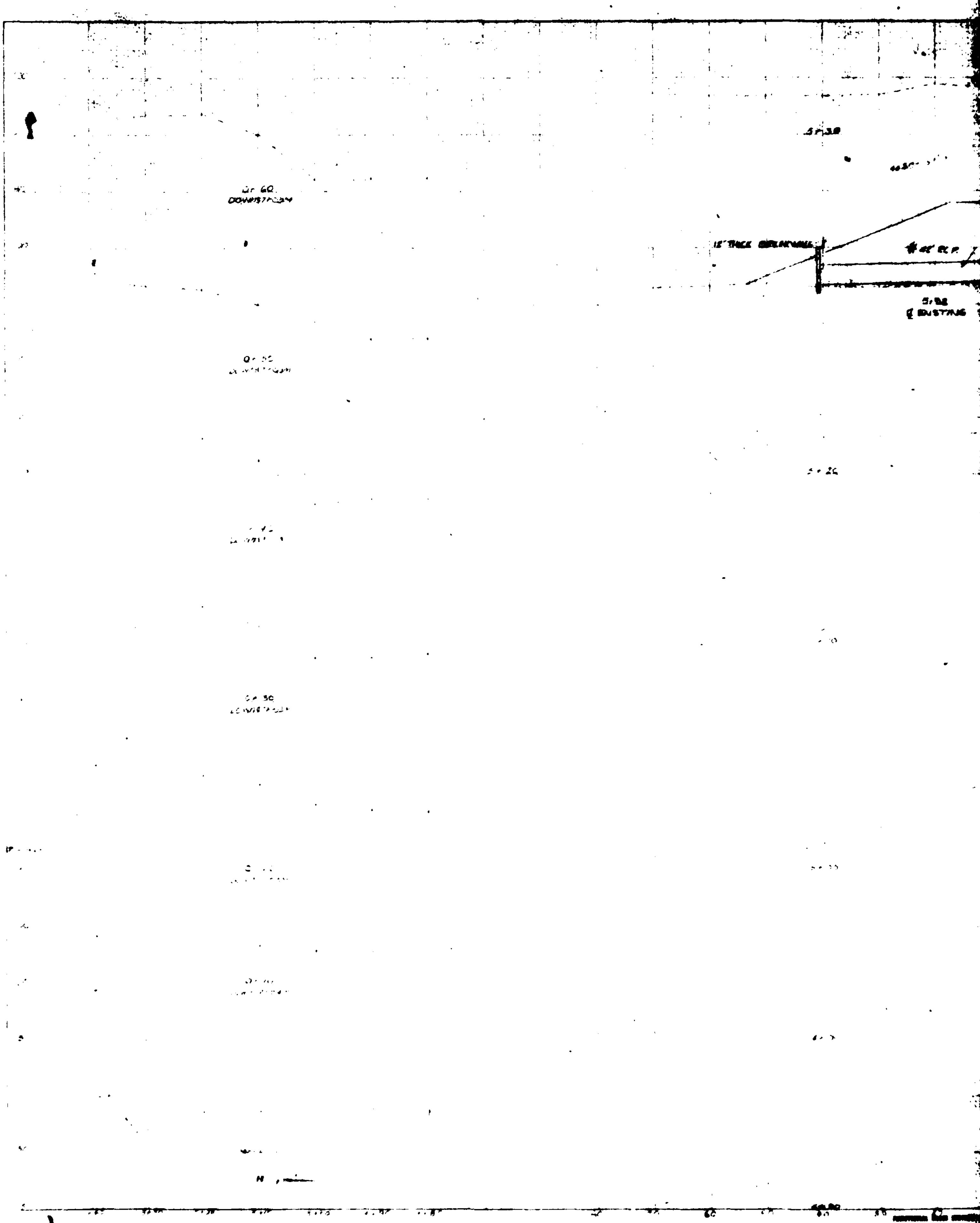
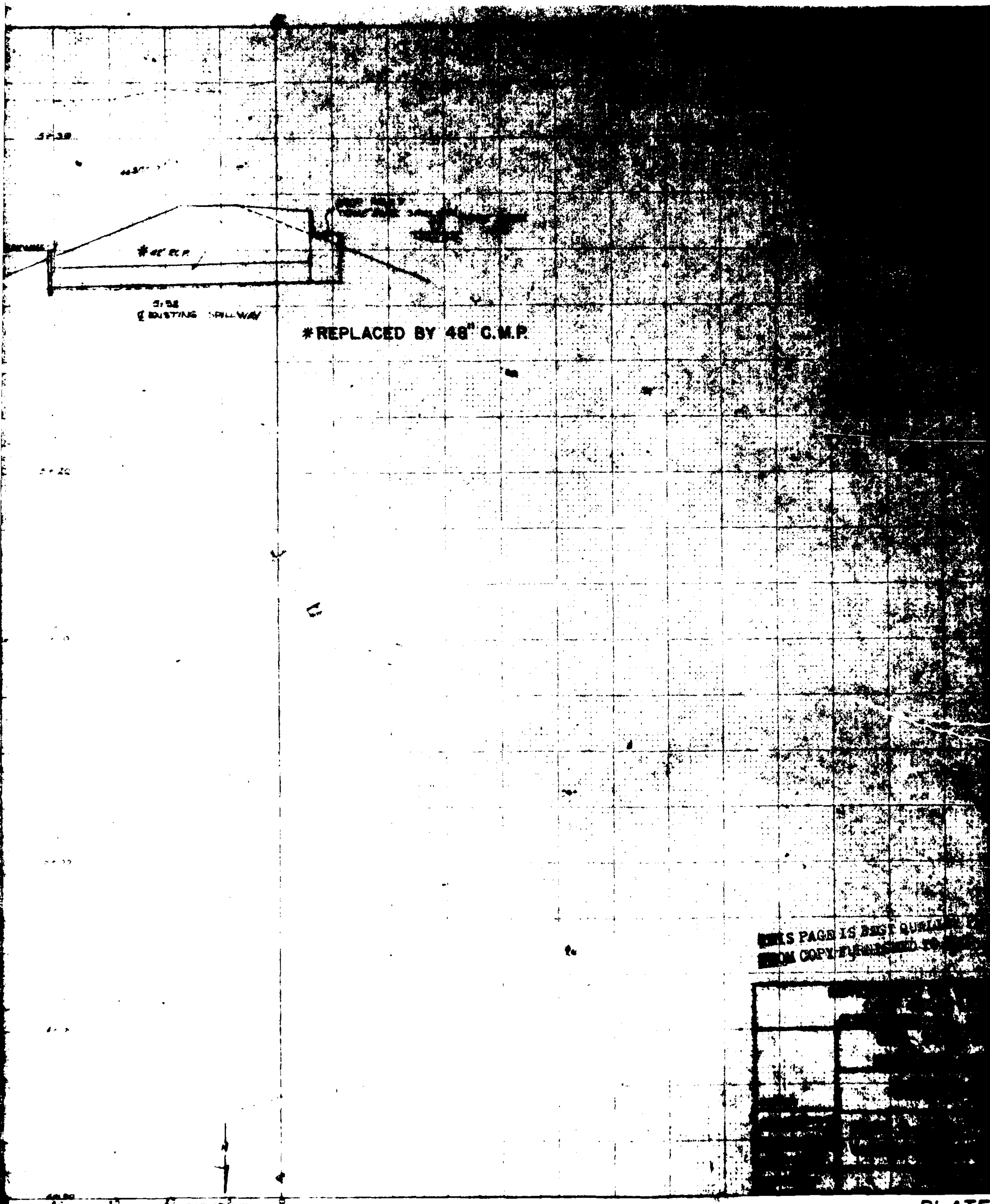

STA 4+80
STA 4+00
STA 5+80
Borrow Logs
Note: Holes E & H are not suitable for borrow
IMPROVEMENT ON EXISTING LAKE
CAMP CEDAR LEDGE
JEFFERSON CO. MISSOURI
GIRL SCOUTS COUNCIL
OF
GREATER ST LOUIS
CROSS SECTION
REITZ & JENS
CONSULTING ENGINEERS
ST. LOUIS, MISSOURI
SHEET 2 OF 3

PLATE 7



St 38
12" THICK BULKHEAD
St 32
℄ EXISTING



PLATE

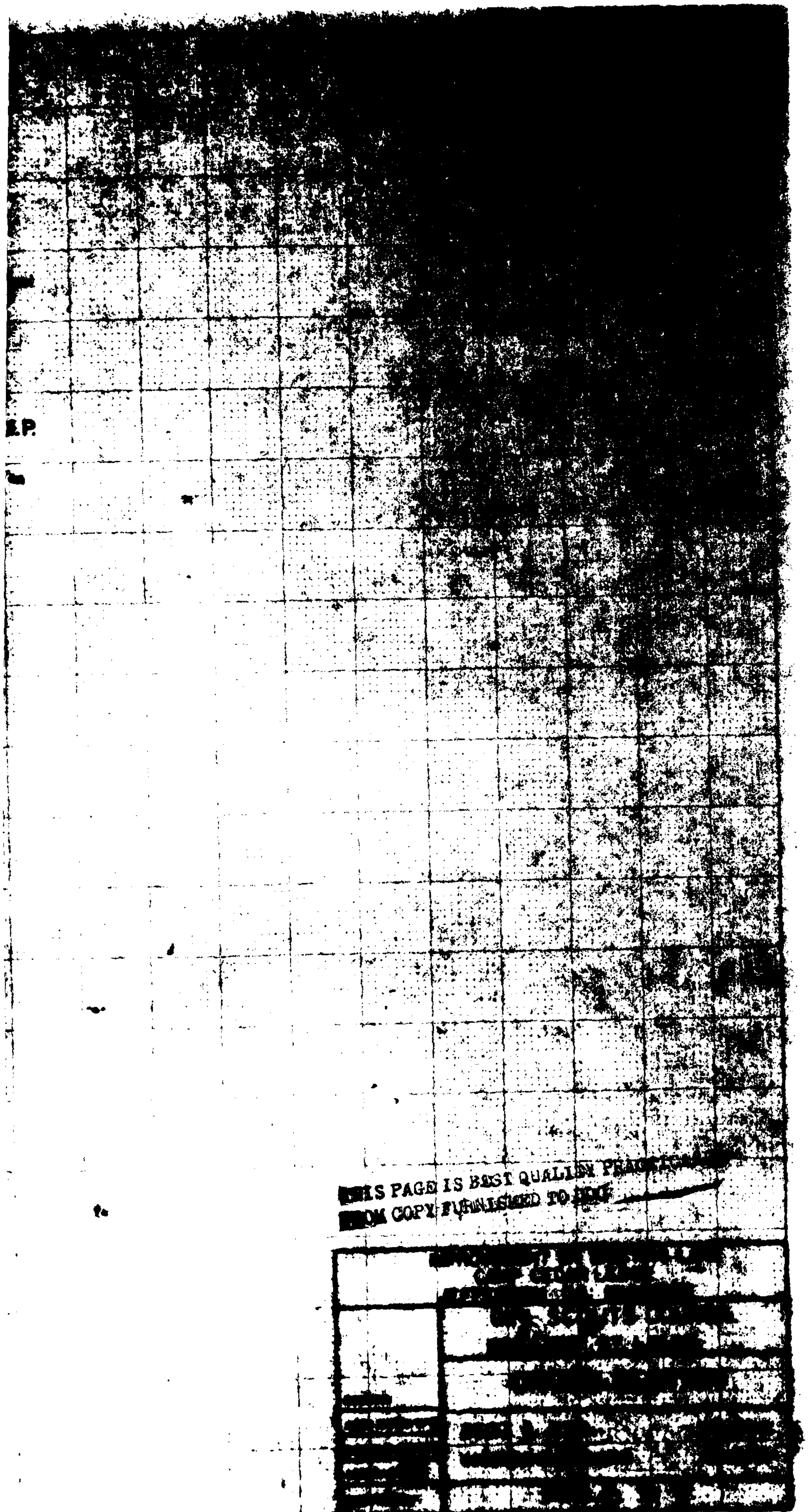
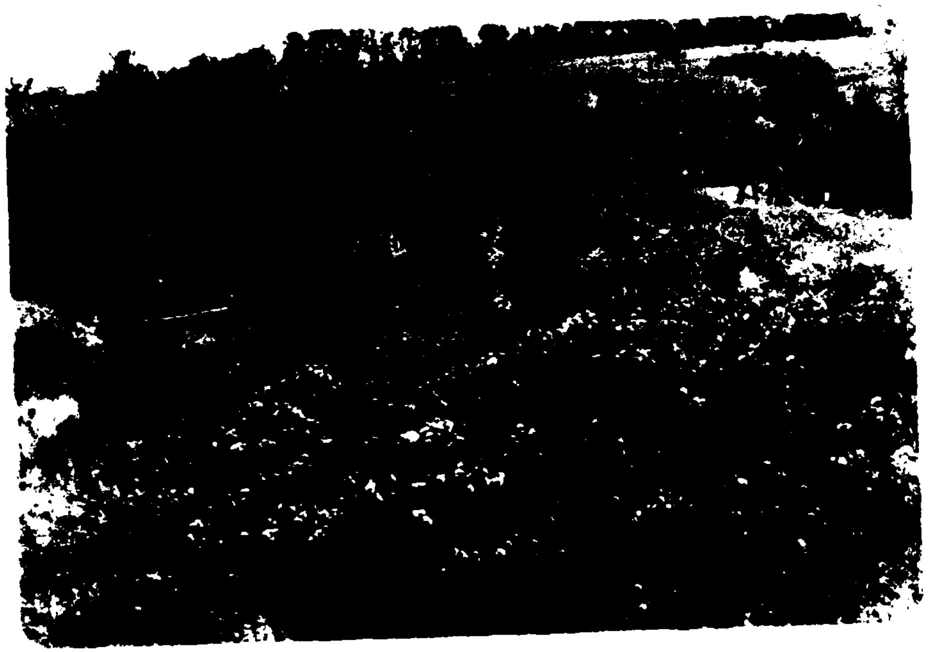


PLATE 8

APPENDIX A

INSPECTION PHOTOGRAPHS



1	2
3	

PHOTO KEY

NO.	DESCRIPTION
1	DAM OVERVIEW
2	UPSTREAM FACE OF DAM
3	DOWNSTREAM FACE OF DAM

4	5
6	

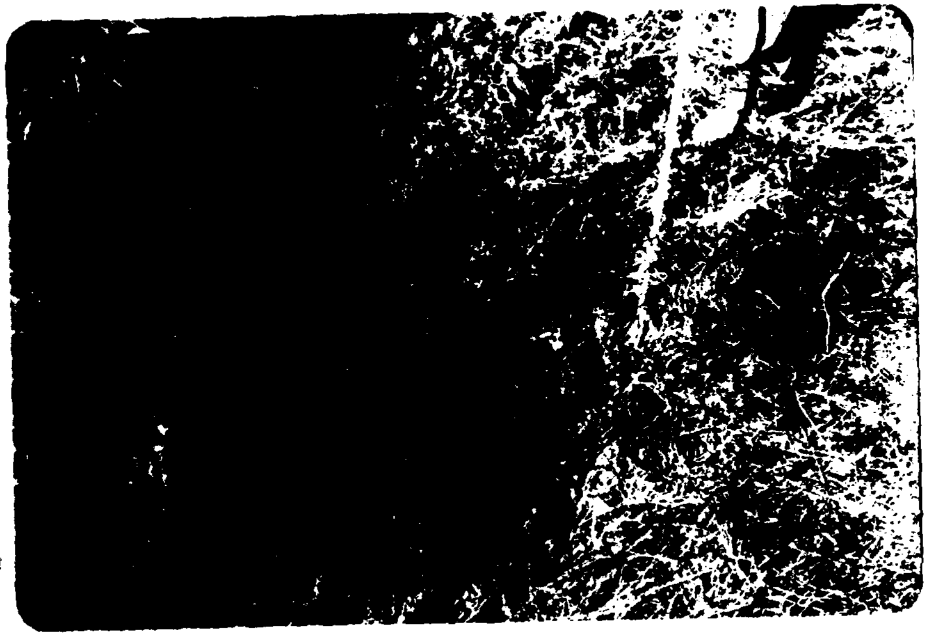
PHOTO KEY

NO.	DESCRIPTION
4	DROP INLET SPILLWAY
5	DOWNSTREAM END OF 48" SPILLWAY OUTLET PIPE
6	PRINCIPAL SPILLWAY OUTLET CHANNEL

7	8
9	

PHOTO KEY

NO.	DESCRIPTION
7	EMERGENCY SPILLWAY
8	EMERGENCY SPILLWAY OUTLET CHANNEL
9	*LAKE DRAWDOWN CONTROL VALVE*



10	11
12	

PHOTO KEY

NO.	DESCRIPTION
10	EROSION OF UPSTREAM SLOPE
11	TREE IN DOWNSTREAM FACE OF DAM
12	EROSION PROTECTION IN EMERGENCY SPILLWAY OUTLET CHANNEL

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.7 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Drainage area = 0.145 square miles = 93 acres.

c. SCS parameters:

Time of Concentration (T_c) = $\left(\frac{11.9L^3}{H}\right)^{0.385}$ = 0.092 hours

Where: T_c = Travel time of water from hydraulically most distant point to point of interest, hours

L = Length of longest watercourse = 0.313 miles

H = Elevation difference = 180 feet

The time of concentration (T_c) was obtained using Method C as described in Figure 30, "Design of Small Dams", by the United States Department of the Interior, Bureau of Reclamation, and was verified using average channel velocity estimates and watercourse lengths.

Lag time = 0.055 hours (0.60 Tc)

Hydrologic Soil Group = 100% D (Gasconade Series, 0.6 wooded, 0.4 meadow per Missouri General Soil Map and field investigation)

Soil type CN = 78 (AMC II, 100-yr flood)
= 90 (AMC III, PMF condition)

2. Spillway releases for the drop inlet spillway were computed utilizing equations and nomographs presented in "Design of Small Dams" by the U. S. Department of the Interior (USDI) for drop inlet type spillways. Flow has access to three sides of the 48-inch square drop inlet; the fourth side consists of a backwall adjacent to the upstream face of the dam. The spillway crest length was converted to an equivalent circular length and corresponding radius for entry into the flow nomograph parameter. The rise of the nappe above the elevation of the crest lip was considered negligible. The following equation was used for crest control:

$$Q = C_o \, (2 \pi R_s) \, H_o^{3/2}$$

where "C_o is a coefficient obtained from Figure 283 of the above reference, expressed in terms of H_o/R_s, "R_s" is the equivalent radius of the spillway crest, 1.91 feet, and "H_o" is the depth of flow over the crest.

When the ratio H_o/R_s reached a value of 1.00, inflow was determined by assuming flow was over a sharp edge submerged orifice. The following equation was used: $Q = Ca\,(2gh)^{0.5}$, where "C" is a coefficient assumed to be 0.7, "a" is the area of the orifice, 16.0 sf, "h" is the height of flow above the orifice, and "g" is acceleration due to gravity. Reference "Handbook of Hydraulics", Fifth Edition, by King & Brater, page 4-3.

Flow through the 48-inch diameter outlet pipe was determined using Bernoulli's equation for pressure flow in pipes. Losses, including entrance, turn, pipe and exit losses totaled 2.99 velocity heads. Reference "Handbook of Hydraulics", Fifth Edition, by King & Brater, pages 8-5 and 8-6.

Discharge quantities, determined by the methods described herein, were plotted versus corresponding lake water surface elevations to determine the discharge rating curve for the drop inlet spillway.

3. The emergency spillway section consists of a broad-crested, trapezoidal section for which conventional weir formulas do not apply.

Spillway release rates were determined as follows:

a. Spillway crest section properties (areas, "a", and top width, "t") were computed for various depths, "d".

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Qc = \left(\frac{a^3 g}{t}\right)^{0.5}$ for the various depths, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.* Reference, "Handbook of Hydraulics", Fifth Edition, by King & Brater, page 8-7.

c. Static lake levels corresponding to the various values passing the spillway were computed as critical depths plus critical velocity heads ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

3. The discharges for the principal and emergency spillways for equal elevations were summated for entry on the Y4 and Y5 cards.

4. The profile of the dam crest is irregular and flow over the dam cannot be determined by application of conventional weir formulas. [illegible] length and elevation data for the dam crest proper were entered into the HEC-1 Program on the $L and $V cards. The program assumes that flow over the dam crest section occurs at critical depth and computes internally the flow passing the dam crest and adds this flow to the flow passing the spillway as entered on the Y4 and Y5 cards.

* $v_c = \frac{Qc}{a}$; $Hvc = \frac{v_c^2}{2g}$

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF ATWOOD LAKE DAM
A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
B   [illegible]                    0        0        0        0        0        0        0
B1       [illegible]
[illegible]
K1       [illegible] HYDROGRAPH
                          0.145                          1.0
               [illegible]    [illegible]    120      130
[illegible]
1A             [illegible]    [illegible]    11.[illegible]  15.1
1B             [illegible]    [illegible]    [illegible]     500
$$ [illegible]
$$ [illegible]
$E             [illegible]    [illegible]    400      40[illegible]   44[illegible]
$V [illegible]  [illegible]    [illegible]    400.2    480.5   481.1
```

```
IA1      ANALYSIS OF DAM OVERTOPPING USING 1 PERCENT PROBABILITY FLOOD
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF ATWOOD LAKE DAM
A3       1 PERCENT PROBABILITY FLOOD ROUTED THROUGH RESERVOIR
B    [illegible]                5                                                  4
B1       5
J        1          1           1
J1   1.  [illegible]
K        0   INFLOW                                          1
K1       INFLOW HYDROGRAPH
M                   1       0.145                   1.0                            1
O    [illegible]   [illegible].?74
[illegible]  .[illegible]  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .007  .007  .007  .007  .007  .007  .007  .007  .007  .007
01   .[illegible]  .007  .012  .012  .012  .012  .012  .012  .012  .012
01   .012  .012  .012  .012  .012  .012  .012  .012  .012  .012
01   .012  .012  .012  .012  .012  .012  .012  .012  .012  .012
01   .[illegible]  .012  .012  .012  .012  .012  .012  .012  .023  .023
01   [illegible]  [illegible]  .023  .023  .023  .023  .023  .023  .023  .023
01   [illegible]  [illegible]  .023  .023  .023  .023  .030  .030  .030  .030
01   [illegible]  [illegible]  .048  .048  .048  .048  .048  .048  .134  .134
01   .134  .255  .255  .546  .017  .380  .255  .134  .134  .134
01   .048  .048  .048  .048  .048  .048  .030  .030  .030  .030
01   [illegible]  .030  .023  .023  .023  .023  .023  .023  .023  .023
01   [illegible]  [illegible]  .023  .023  .023  .023  .023  .023  .023  .023
```

1 PERCENT PROBABILITY FLOOD (cont'd)

01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007		
T							-1	-78		
W2		0.055								
Y	-1.0	-.10	2.0							
K	1	DAM					1			
K1	RESERVOIR ROUTING [illegible]									
[illegible]				1	1					
Y1	1						42.60	-1		
Y4	475	475.36	475.76	47[illegible]	[illegible]	477.00	477.21	478.06	478.75	47[illegible]
Y4	480.08	480.74	481.20	481.[illegible]	[illegible]	482.[illegible]	483.41	484.16	484.91	
Y5	0	11	29	[illegible]	[illegible]	132	147	256	391	550
Y5	747	981	1180	[illegible]	[illegible]	2022	2613	3307	4070	
$A	0	7.1	8.7	11.7	[illegible]					
$E	457	475	480	[illegible]	500					
$$	475.0									
$D	[illegible]									
$L	0	[illegible]	154	[illegible]	[illegible]	437	449	472		
$V	[illegible]	[illegible]	480.[illegible]	[illegible]	[illegible]	[illegible]	481.1	488.5		
[illegible]	[illegible]									

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF ATWOOD LAKE DAM
RATIOS OF PMF ROUTED THROUGH RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .4[illegible] .4[illegible] .5[illegible] 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.15	0.00	.15	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.70	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-90.00	0.00	0.00

CURVE NO = -90.00 WETNESS = -1.00 EFFECT CN = 90.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .06

RECESSION DATA
STRTQ= 1.00 QRCSN= .10 RTIOR= 2.00

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .06 VOL= 1.00
698. 320. 79. [illegible]. 5.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.22	.21	.01	175.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.22	.21	.01	223.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.22	.21	.01	235.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.22	.21	.01	239.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.22	.21	.00	240.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.22	.21	.00	240.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.22	.21	.00	240.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.22	.21	.00	241.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.22	.21	.00	241.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.22	.21	.00	241.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.22	.21	.00	241.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.22	.22	.00	241.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.26	.00	272.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.26	.26	.00	286.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.26	.26	.00	289.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.20	160	.26	.26	.00	290.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.26	.26	.00	291.
1.01	1.30	18	.01	.00	.01	1.	1.01	13.30	162	.26	.26	.00	291.
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.26	.26	.00	291.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.26	.26	.00	291.
1.01	1.45	21	.01	.00	.01	2.	1.01	13.45	165	.26	.26	.00	291.
1.01	1.50	22	.01	.00	.01	2.	1.01	13.50	166	.26	.26	.00	291.
1.01	1.55	23	.01	.00	.01	2.	1.01	13.55	167	.26	.26	.00	292.
1.01	2.00	24	.01	.00	.01	3.	1.01	14.00	168	.26	.26	.00	292.
1.01	2.05	25	.01	.00	.01	3.	1.01	14.05	169	.33	.33	.00	337.
1.01	2.10	26	.01	.00	.01	3.	1.01	14.10	170	.33	.33	.00	358.
1.01	2.15	27	.01	.00	.01	4.	1.01	14.15	171	.33	.33	.00	363.
1.01	2.20	28	.01	.00	.01	4.	1.01	14.20	172	.33	.33	.00	365.
1.01	2.25	29	.01	.00	.01	4.	1.01	14.25	173	.33	.33	.00	365.
1.01	2.30	30	.01	.00	.01	4.	1.01	14.30	174	.33	.33	.00	365.
1.01	2.35	31	.01	.00	.01	5.	1.01	14.35	175	.33	.33	.00	366.
1.01	2.40	32	.01	.00	.01	5.	1.01	14.40	176	.33	.33	.00	366.
1.01	2.45	33	.01	.00	.01	5.	1.01	14.45	177	.33	.33	.00	366.
1.01	2.50	34	.01	.00	.01	5.	1.01	14.50	178	.33	.33	.00	366.
1.01	2.55	35	.01	.01	.01	6.	1.01	14.55	179	.33	.33	.00	366.
1.01	3.00	36	.01	.01	.01	6.	1.01	15.00	180	.33	.33	.00	366.
1.01	3.05	37	.01	.01	.01	6.	1.01	15.05	181	.20	.20	.00	277.
1.01	3.10	38	.01	.01	.01	6.	1.01	15.10	182	.40	.40	.00	374.
1.01	3.15	39	.01	.01	.01	6.	1.01	15.15	183	.40	.40	.00	428.
1.01	3.20	40	.01	.01	.01	7.	1.01	15.20	184	.60	.60	.00	580.
1.01	3.25	41	.01	.01	.01	7.	1.01	15.25	185	.70	.69	.00	716.
1.01	3.30	42	.01	.01	.01	7.	1.01	15.30	186	1.69	1.69	.01	1458.
1.01	3.35	43	.01	.01	.01	7.	1.01	15.35	187	2.79	2.78	.01	2551.
1.01	3.40	44	.01	.01	.01	7.	1.01	15.40	188	1.10	1.09	.00	1804.
1.01	3.45	45	.01	.01	.01	7.	1.01	15.45	189	.70	.70	.00	1003.
1.01	3.50	46	.01	.01	.01	8.	1.01	15.50	190	.60	.60	.00	789.
1.01	3.55	47	.01	.01	.01	8.	1.01	15.55	191	.40	.40	.00	560.
1.01	4.00	48	.01	.01	.01	8.	1.01	16.00	192	.40	.40	.00	472.
1.01	4.05	49	.01	.01	.01	8.	1.01	16.05	193	.31	.31	.00	387.
1.01	4.10	50	.01	.01	.01	8.	1.01	16.10	194	.31	.31	.00	353.
1.01	4.15	51	.01	.01	.01	8.	1.01	16.15	195	.31	.31	.00	345.

1.01	4.20	52	.01	.01	.01	9.	1.01	16.20	196	.31	.31	.00	343.
1.01	4.25	53	.01	.01	.01	9.	1.01	16.25	197	.31	.31	.00	343.
1.01	4.30	54	.01	.01	.01	9.	1.01	16.30	198	.31	.31	.00	343.
1.01	4.35	55	.01	.01	.01	9.	1.01	16.35	199	.31	.31	.00	343.
1.01	4.40	56	.01	.01	.01	9.	1.01	16.40	200	.31	.31	.00	343.
1.01	4.45	57	.01	.01	.01	9.	1.01	16.45	201	.31	.31	.00	343.
1.01	4.50	58	.01	.01	.01	9.	1.01	16.50	202	.31	.31	.00	343.
1.01	4.55	59	.01	.01	.01	9.	1.01	16.55	203	.31	.31	.00	343.
1.01	5.00	60	.01	.01	.01	9.	1.01	17.00	204	.31	.31	.00	343.
1.01	5.05	61	.01	.01	.01	10.	1.01	17.05	205	.24	.24	.00	297.
1.01	5.10	62	.01	.01	.01	10.	1.01	17.10	206	.24	.24	.00	278.
1.01	5.15	63	.01	.01	.01	10.	1.01	17.15	207	.24	.24	.00	271.
1.01	5.20	64	.01	.01	.01	10.	1.01	17.20	208	.24	.24	.00	270.
1.01	5.25	65	.01	.01	.01	10.	1.01	17.25	209	.24	.24	.00	269.
1.01	5.30	66	.01	.01	.01	10.	1.01	17.30	210	.24	.24	.00	269.
1.01	5.35	67	.01	.01	.01	10.	1.01	17.35	211	.24	.24	.00	269.
1.01	5.40	68	.01	.01	.01	10.	1.01	17.40	212	.24	.24	.00	269.
1.01	5.45	69	.01	.01	.01	10.	1.01	17.45	213	.24	.24	.00	269.
1.01	5.50	70	.01	.01	.00	10.	1.01	17.50	214	.24	.24	.00	269.
1.01	5.55	71	.01	.01	.00	10.	1.01	17.55	215	.24	.24	.00	269.
1.01	6.00	72	.01	.01	.00	11.	1.01	18.00	216	.24	.24	.00	269.
1.01	6.05	73	.06	.04	.02	34.	1.01	18.05	217	.02	.02	.00	240.
1.01	6.10	74	.06	.04	.02	46.	1.01	18.10	218	.02	.02	.00	224.
1.01	6.15	75	.06	.05	.02	50.	1.01	18.15	219	.02	.02	.00	209.
1.01	6.20	76	.06	.05	.02	52.	1.01	18.20	220	.02	.02	.00	195.
1.01	6.25	77	.06	.05	.02	53.	1.01	18.25	221	.02	.02	.00	182.
1.01	6.30	78	.06	.05	.02	54.	1.01	18.30	222	.02	.02	.00	169.
1.01	6.35	79	.06	.05	.01	55.	1.01	18.35	223	.02	.02	.00	158.
1.01	6.40	80	.06	.05	.01	56.	1.01	18.40	224	.02	.02	.00	146.
1.01	6.45	81	.06	.05	.01	57.	1.01	18.45	225	.02	.02	.00	136.
1.01	6.50	82	.06	.05	.01	58.	1.01	18.50	226	.02	.02	.00	128.
1.01	6.55	83	.06	.05	.01	59.	1.01	18.55	227	.02	.02	.00	120.
1.01	7.00	84	.06	.05	.01	59.	1.01	19.00	228	.02	.02	.00	112.
1.01	7.05	85	.06	.05	.01	60.	1.01	19.05	229	.02	.02	.00	104.
1.01	7.10	86	.06	.05	.01	60.	1.01	19.10	230	.02	.02	.00	97.
1.01	7.15	87	.06	.05	.01	61.	1.01	19.15	231	.02	.02	.00	91.
1.01	7.20	88	.06	.05	.01	61.	1.01	19.20	232	.02	.02	.00	85.
1.01	7.25	89	.06	.06	.01	62.	1.01	19.25	233	.02	.02	.00	79.
1.01	7.30	90	.06	.06	.01	62.	1.01	19.30	234	.02	.02	.00	74.
1.01	7.35	91	.06	.06	.01	63.	1.01	19.35	235	.02	.02	.00	69.
1.01	7.40	92	.06	.06	.01	63.	1.01	19.40	236	.02	.02	.00	64.
1.01	7.45	93	.06	.06	.01	63.	1.01	19.45	237	.02	.02	.00	60.
1.01	7.50	94	.06	.06	.01	64.	1.01	19.50	238	.02	.02	.00	56.
1.01	7.55	95	.06	.06	.01	64.	1.01	19.55	239	.02	.02	.00	52.
1.01	8.00	96	.06	.06	.01	64.	1.01	20.00	240	.02	.02	.00	49.
1.01	8.05	97	.06	.06	.01	65.	1.01	20.05	241	.02	.02	.00	45.
1.01	8.10	98	.06	.06	.01	65.	1.01	20.10	242	.02	.02	.00	42.
1.01	8.15	99	.06	.06	.01	65.	1.01	20.15	243	.02	.02	.00	40.
1.01	8.20	100	.06	.06	.01	65.	1.01	20.20	244	.02	.02	.00	37.
1.01	8.25	101	.06	.06	.01	66.	1.01	20.25	245	.02	.02	.00	34.
1.01	8.30	102	.06	.06	.01	66.	1.01	20.30	246	.02	.02	.00	32.
1.01	8.35	103	.06	.06	.01	66.	1.01	20.35	247	.02	.02	.00	30.

1.01	8.40	104	.06	.06	.01	66.	1.01	20.40	248	.02	.02	.00	23.
1.01	8.45	105	.06	.06	.00	66.	1.01	20.45	249	.02	.02	.00	23.
1.01	8.50	106	.06	.06	.00	67.	1.01	20.50	250	.02	.02	.00	24.
1.01	8.55	107	.06	.06	.00	67.	1.01	20.55	251	.02	.02	.00	24.
1.01	9.00	108	.06	.06	.00	67.	1.01	21.00	252	.02	.02	.00	24.
1.01	9.05	109	.06	.06	.00	67.	1.01	21.05	253	.02	.02	.00	24.
1.01	9.10	110	.06	.06	.00	67.	1.01	21.10	254	.02	.02	.00	24.
1.01	9.15	111	.06	.06	.00	67.	1.01	21.15	255	.02	.02	.00	24.
1.01	9.20	112	.06	.06	.00	68.	1.01	21.20	256	.02	.02	.00	24.
1.01	9.25	113	.06	.06	.00	68.	1.01	21.25	257	.02	.02	.00	24.
1.01	9.30	114	.06	.06	.00	68.	1.01	21.30	258	.02	.02	.00	24.
1.01	9.35	115	.06	.06	.00	68.	1.01	21.35	259	.02	.02	.00	24.
1.01	9.40	116	.06	.06	.00	68.	1.01	21.40	260	.02	.02	.00	24.
1.01	9.45	117	.06	.06	.00	68.	1.01	21.45	261	.02	.02	.00	24.
1.01	9.50	118	.06	.06	.00	68.	1.01	21.50	262	.02	.02	.00	24.
1.01	9.55	119	.06	.06	.00	68.	1.01	21.55	263	.02	.02	.00	24.
1.01	10.00	120	.06	.06	.00	68.	1.01	22.00	264	.02	.02	.00	24.
1.01	10.05	121	.06	.06	.00	69.	1.01	22.05	265	.02	.02	.00	24.
1.01	10.10	122	.06	.06	.00	69.	1.01	22.10	266	.02	.02	.00	24.
1.01	10.15	123	.06	.06	.00	69.	1.01	22.15	267	.02	.02	.00	24.
1.01	10.20	124	.06	.06	.00	69.	1.01	22.20	268	.02	.02	.00	24.
1.01	10.25	125	.06	.06	.00	69.	1.01	22.25	269	.02	.02	.00	24.
1.01	10.30	126	.06	.06	.00	69.	1.01	22.30	270	.02	.02	.00	24.
1.01	10.35	127	.06	.06	.00	69.	1.01	22.35	271	.02	.02	.00	24.
1.01	10.40	128	.06	.06	.00	69.	1.01	22.40	272	.02	.02	.00	24.
1.01	10.45	129	.06	.06	.00	69.	1.01	22.45	273	.02	.02	.00	24.
1.01	10.50	130	.06	.06	.00	69.	1.01	22.50	274	.02	.02	.00	24.
1.01	10.55	131	.06	.06	.00	69.	1.01	22.55	275	.02	.02	.00	24.
1.01	11.00	132	.06	.06	.00	69.	1.01	23.00	276	.02	.02	.00	24.
1.01	11.05	133	.06	.06	.00	69.	1.01	23.05	277	.02	.02	.00	24.
1.01	11.10	134	.06	.06	.00	69.	1.01	23.10	278	.02	.02	.00	24.
1.01	11.15	135	.06	.06	.00	70.	1.01	23.15	279	.02	.02	.00	24.
1.01	11.20	136	.06	.06	.00	70.	1.01	23.20	280	.02	.02	.00	24.
1.01	11.25	137	.06	.06	.00	70.	1.01	23.25	281	.02	.02	.00	24.
1.01	11.30	138	.06	.06	.00	70.	1.01	23.30	282	.02	.02	.00	24.
1.01	11.35	139	.06	.06	.00	70.	1.01	23.35	283	.02	.02	.00	24.
1.01	11.40	140	.06	.06	.00	70.	1.01	23.40	284	.02	.02	.00	24.
1.01	11.45	141	.06	.06	.00	70.	1.01	23.45	285	.02	.02	.00	24.
1.01	11.50	142	.06	.06	.00	70.	1.01	23.50	286	.02	.02	.00	24.
1.01	11.55	143	.06	.06	.00	70.	1.01	23.55	287	.02	.02	.00	24.
1.01	12.00	144	.06	.06	.00	70.	1.02	0.00	288	.02	.02	.00	24.

SUM 33.41 32.11 1.30 38331.
(849.)(816.)(33.)(1085.41)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2551.	406.	133.	133.	38319.
CMS	72.	11.	4.	4.	1085.
INCHES		26.03	34.14	34.14	34.14
MM		661.23	867.25	867.25	867.25
AC-FT		201.	264.	264.	264.
THOUS CU M		248.	326.	326.	326.

SURFACE AREA=	0.	7.	9.	12.	16.
CAPACITY=	0.	43.	72.	184.	322.
ELEVATION=	457.	475.	480.	490.	500.

SUMMARY OF DAM SAFETY ANALYSIS

PMF

....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	475.00	475.00	478.00
STORAGE	43.	43.	72.
OUTFLOW	0.	0.	403.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.42	[illegible]	0.00	71.	392.	0.00	[illegible]	0.00
.43	478.02	.02	72.	407.	.17	15.75	0.00
.50	478.43	.43	75.	504.	.42	15.75	0.00
1.00	480.08	2.08	[illegible]	1994.	[illegible]	[illegible]	0.00

SUMMARY OF DAM SAFETY ANALYSIS

1% PROBABILITY FLOOD

....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	475.00	475.00	478.00
STORAGE	43.	43.	72.
OUTFLOW	0.	0.	403.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	477.05	0.00	58.	135.	0.00	12.50	0.00

ATE
LME